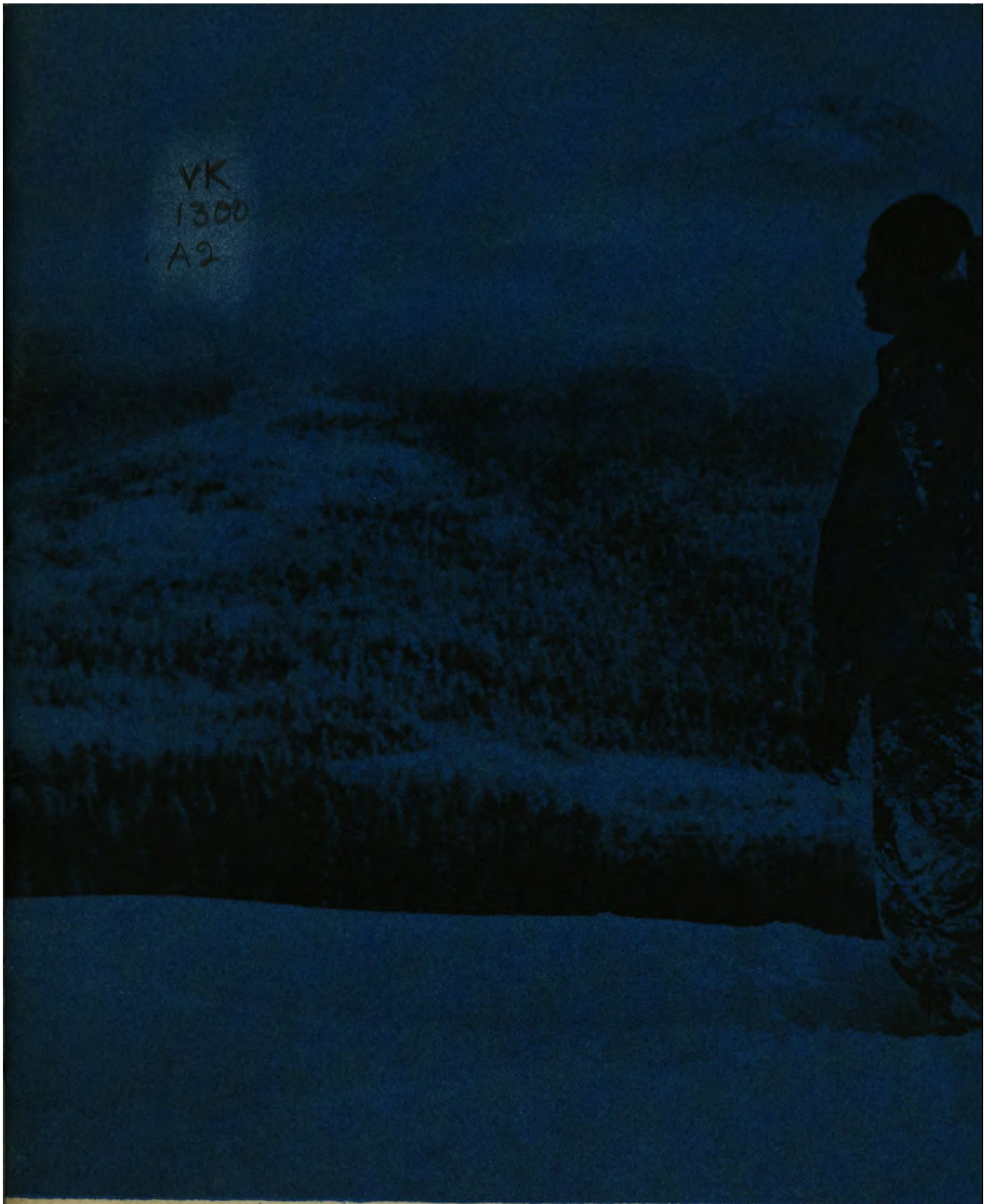

Air Sea Rescue

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air sea rescue bulletin

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THIS MONTH'S COVER. Viewed in retrospect, this official U. S. Navy photograph would delight the eye of many an artist . . . yet, to the fighting man on the end of the strings, it represents the end of a mission—a landing to come—and the wait for rescue, with unknown adventure in between.

the philosophy of search and rescue

WHEN we look at a map of present and proposed world airways, we are impressed with the preponderance of mileage over water, and over sparsely populated land areas along these routes. Granted that a world war was responsible for making these long-range flights a practical reality, we can be assured that aviation will never again be held within the limits of any one continent, or to relatively short stretches over water.

How much flying over these vast reaches of land and water we may expect in the future will largely depend on the manner and degree of the public's acceptance. There are many reasons why it should be high. Time and money may be saved, comfort enjoyed. What then, could be expected to interfere with complete acceptance? The answer is likely to be . . . lack of confidence based upon the hazards involved.

It is not enough to point out to the potential air traveler that the proportion of aircraft disasters to miles flown is amazingly low; that ships at sea also founder, that trains are sometimes wrecked. Aircraft disasters are still "front page" . . . and a factor which has impressed this traveler unfavorably, has been the small number of survivors in these accidents.

On the other hand, when we examine the wartime statistics of flyers downed in combat, we find that a relatively high percentage of them were rescued, and under conditions which were generally unfavorable.

The reason why so many of these men were saved is because an organized, competent search and rescue service supported combat operations in all theaters of the war. Organization and equipment varied considerably, but basic principles were the same and rescue teams were constantly alert to their responsibilities. Because these combat airmen were aware that an efficient search and rescue service was there to help them, their morale was stepped up, they fought more aggressively. They were willing to fly farther from the security of their bases, confident their chances for rescue and survival were good.

The way to inspire public confidence in aviation is to persuade the potential air traveler that he is completely safe in the air, that he may relax, cease his worries, that there are no risks off the ground which are not encounterable in life's well-known uncertainties on the ground. The idea should be presented to him that search and rescue was solidly there before he came. Further, we must prove to him that the percentage of survivors in aircraft accidents is higher because of search and rescue . . . and that, while it cannot guarantee his safety, it does provide him with the maximum of protection.

It is assumed that transoceanic carriers will themselves supplement the search and rescue organization by carrying equipment which will make effective cooperation possible. Thus they will assist in attaining the desired international standards of safety. Certainly it is more desirable for the carriers to accept this responsibility in their own right, than to risk the possibility of Government-imposed regulation which, conceivably, might contain undesirable elements of rigidity or inflexibility.

It may well be that long periods of time will elapse when search and rescue will not be called upon for service. So much the better. In fact, it is to be hoped that international air transport may some day achieve standards of safe operation which may totally eliminate its need. Until that time, however, it is a necessary adjunct to our daily lives. It will contribute invaluably toward the attainment of high standards of safety. It will stimulate confidence in aviation . . . and because friendliness between nations, based upon humanitarianism and good will, is a guiding principle for world peace, a world-wide search and rescue organization will materially assist in adding the breath of life to those principles.

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evolution of SAR . . . *an editorial*

Much has been written concerning the history and development of air sea rescue and its peacetime connotation—search and rescue. Yet, because of its sudden emergence from behind a screen of wartime secrecy, and its swift transition from a wartime life-saving function to that of an organized pattern to provide the highest standards of safety to a world-wide airways system—civil and military—it is believed that a reiteration of the story of its evolution and development will serve two useful purposes: (1) It will provide a fund of information upon which we may better evaluate its progress; (2) it will make possible a better understanding of its potentials for service to international aviation. While it may appear to be an old story to those of us who have been intimately associated with the development of air sea rescue, it is nevertheless true that the foundation upon which its future progress will depend will be that which is built upon a complete public understanding of its value.

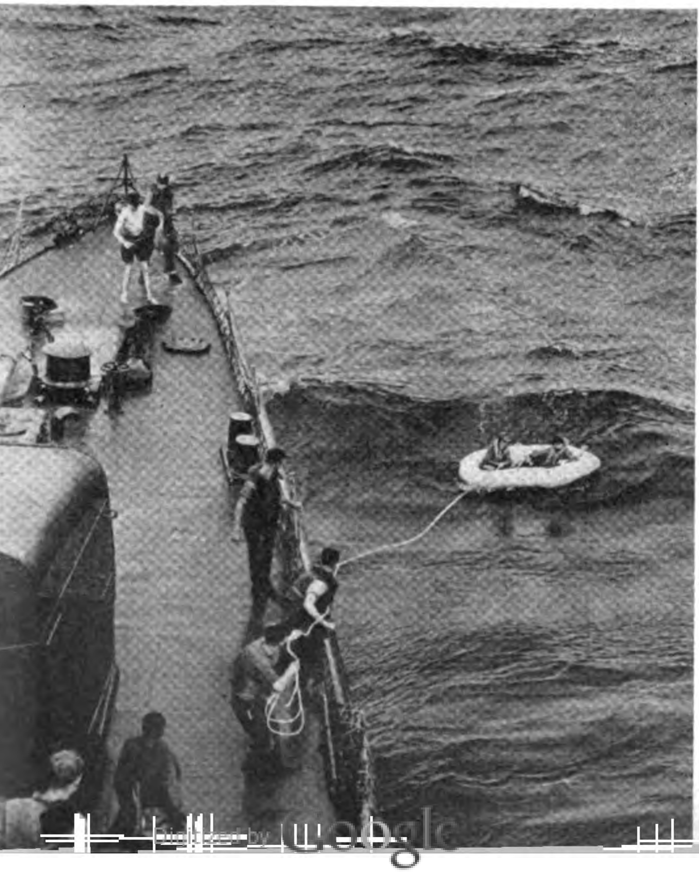
"TO MEN who fly and sail over thousands of miles of water each day—the term 'Air Sea Rescue' spells magic—magic in the sense that powerful forces which frequently combine to destroy have been met and largely conquered by another powerful force that champions survival." These words of Rear Admiral J. W. Reeves, Jr., Commander of the Naval Air Transport Service sum up what airmen and mariners who traverse long stretches of open water think of air sea rescue.

The ordinary individual has only a vague conception of air sea rescue and is likely to tell you that distance no longer means anything. He is thinking of a multi-motored plane with plenty of fuel; he is not visualizing the 68,634,000 square miles of the Pacific as seen from a 7-foot emergency life raft. This same uninitiate is unable to grasp the empty loneliness of the ocean into which a plane or vessel can disappear. He understands only dimly the problems of distance, climate, weather and currents which face the rescue parties who search for the crew of that plane or ship with aircraft and surface vessels. His knowledge of air sea

rescue is comprised of a few well-publicized accounts of dramatic rescues; he knows and understands little or nothing of the extent of the organization that, operating back stage, made these rescues possible. He knows nothing of its exhaustive tests to find the best type of boats for rescue work—the long hours of patient research and development in the field of rescue and survival equipment.

Before World War II there was little need for an extensive air sea rescue organization. Few planes attempted the long overwater flight across the Pacific, and flying under adverse weather conditions was negligible. Most forced landings of aircraft were probably due to mechanical failure, and international merchant shipping services were considered sufficient to care for them, and for the comparatively few cases of marine disaster.

With the advent of war this picture changed rapidly. All types of aircraft were required to fly over water in all kinds of weather. Due to the necessity of speeded-up training, inexperience, according to peacetime standards, was the rule rather than the exception among pilots and crew. Added to these were the normal hazards of war. As a result, forced landings and ditchings increased rapidly, increasing numbers of vessels were sunk or disabled, and with this situation came the need for an increasing rescue coordination.



Official recognition came in May 1940, when the original British Air Sea Resue Unit was formed in the critical Dover area. The outstanding success of this small unit, not only in saving lives but in increasing the morale of airmen, gave impetus to the service. By September 1941, a deputy directorate of air sea rescue was established as a branch of the office of the British Directorate General of Aircraft Safety and under this unified command responsibility was placed jointly upon fighter, coastal, and naval commands.

Under this plan air sea rescue made rapid growth. Numerous aircraft were allotted for full-time rescue duty; a communications network was set up to handle distress calls; survival equipment was placed aboard planes; and a specialized rescue-training school was established at Blackpool. This school was later made available to United States Eighth Air Force officers when American air sea rescue was still in its early stages of organization.

Prior to the United States' entry into the war, there was no comprehensive American air sea rescue plan or program. The Coast Guard had developed some of its aspects but, on the whole, purely local facilities were used, and the practice of diverting commercial surface craft in cases of forced landing at sea had grown up parallel with prewar aviation advancement.

This faint pioneering, combined with the experiences of the British, served as a nucleus for the present American unit. Pending the manufacture of equipment and the development of air sea rescue organization, it was necessary for the Navy in 1942–43 to assign Dumbo squadrons and VH units to rescue work. In February 1944, the joint chiefs of staff recognized the requirement and necessity for rapid joint service development of air-sea rescue equipment, procedures, and techniques, and requested the Secretary of the Navy to establish in the Coast Guard the Air Sea Rescue Agency to coordinate studies conducted in these fields by the various United States services, and to maintain liaison with services of allied governments.

The joint military service nature of the agency characterized its organization. It is headed by the Commandant of the Coast Guard, who is assisted by a board on which are represented the Army Air Forces, the Army Service Forces and the Navy. Liaison with air sea rescue agencies of allied nations is carried on through working contacts with their missions in the United States. Liaison with the services

Survivors of a ditching in the Pacific rescued by a Navy destroyer—part of the wartime rescue team.—U. S. Navy photo.

In Labrador, a Coast Guard helicopter evacuates the first of 11 survivors of two plane crashes in the icy wilderness.—Coast Guard photo.

of the United States is maintained through liaison officers from the agency attached to combat theater and frontier commands; through liaison officers from the respective services attached to the full-time staff of the agency; and through agency and respective service representation on Agency committees which report to the head of the agency and his board on the following subjects: (1) emergency and survival publications, (2) adequacy of air sea rescue facilities, (3) communication facilities and requirements for air sea rescue, (4) special aircraft equipment for rescue and survival, (5) lifesaving equipment on transports, (6) medical and physiological aspects of air sea rescue, and (7) ditching procedures.

The Air Sea Rescue Agency is not to be confused with the Coast Guard's Office of Air Sea Rescue. The difference between them lies in the fact that while the Agency is charged primarily with the collection and distribution of information concerning the development of equipment, procedures, and techniques, and coordinating studies in these fields for the benefit of United States and allied military services—the Coast Guard's air sea rescue organization is an integral part of its office of operations.

In August 1944 the commander in chief of the Navy directed sea frontier commanders to establish centralized control for air sea rescue operations, and the Coast Guard, under frontier commands, to furnish facilities and personnel for these operations. In the same months Army authorities, with the background of their ETO experience, established air sea rescue organizations at strategic points, particularly in Alaska and along Air Transport Command routes. This action was taken by the Army Air Forces while completing the organization of its air-land rescue system, with special emphasis on requirements in the western mountain regions of the United States under the Second and Fourth Air Forces.

Also, under American command, the necessity for maintaining close operational liaison with allied forces, was not without significance in the execution of plans.

Such liaison was required especially in tropical survival, communications, the protection of rescue aircraft in coordination with attacks at both long and short ranges, and coordination with expanded rescue facilities which include the use of submarines.

Air sea rescue projects were practical ones, not theoretical. The Committee to Study Special Equipment for Rescue and Survival was especially effective in achieving practical coordination through committee discussions and information exchange.

Admiral Russel R. Waesche, then Commandant of the Coast Guard and Head of Air Sea Rescue, very clearly outlined the important role air sea rescue played during the war when he said, "Our aviators and seamen, with confidence that they will fly and sail again tomorrow, dare to face greater odds in the war today. Vision of our services, and ingenuity of industry have provided survival and rescue equipment which has lessened the hazards, improved the safety, and given our men greater courage. May we never be content with present equipment, but constantly improve it with experience, continued study and cooperative effort."

As the war progressed, the research and development organizations of the Army and Navy, together with those established by Presidential directives, such as the Office of Inventions, the National Defense Research Committee and others, were instrumental in developing much new equipment which later was used successfully in the field. All of the research units cooperated wholeheartedly in the development of equipment and worked diligently to meet field requirements.

Safe . . . these British merchant ship survivors climb aboard a Coast Guard rescue vessel.—Coast Guard photo.

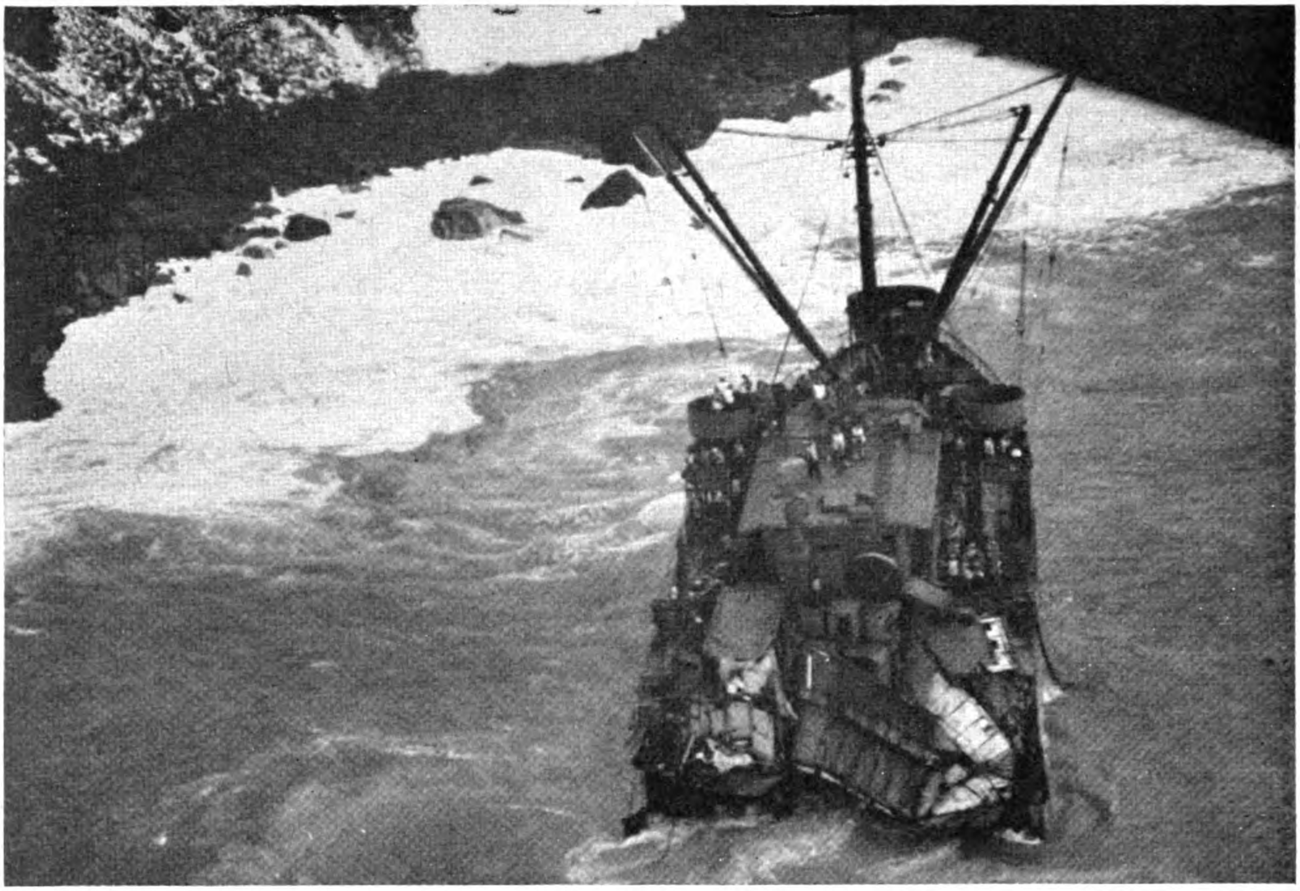
Numerous new equipment items were developed and distributed. The quick-donning exposure suit, for example, was used by fliers in multiplace aircraft to afford protection against exposure in the cold regions of the world where planes flew over the water. In addition, there was developed a continuous-wear exposure suit to be worn by fliers in aircraft where the available space precluded donning a separate exposure suit.

Sea marker dye was a war invention, and later each Mae West was equipped with two packages of it. To protect the survivor from attacks by sharks and other carnivorous fish, shark packet repellent was developed and also attached to each life vest.

The various types of pneumatic rafts available today contain the latest equipment, including such recent items as the hand-held day and night distress signal, which produces a dense cloud of orange-colored smoke for daytime use and a brilliant flare at night; the signalling mirror, which is equipped with an aiming device, enabling the operator to direct the rays of the sun to searching craft and thus indicate his position; the Very projector kit containing a hand projector and six signal cartridges; the pyrotechnic signal pistol and six aircraft parachute flares; the corner reflector, which, when erected on a raft or life boat, can be picked up by search radar; the solar still, which will produce an average of 750 cc. of drinking water from sea water in an 8-hour period; the chemical drinking water kit, a complete unit of which will produce approximately 5 pints of potable water from sea water.

Several aerial delivery kits developed by the AAF to be dropped to survivors in all areas of the world provide virtually unlimited equipment, food, water, and medical supplies to sustain survivors until they are rescued. The Navy had developed the shipwreck kit, rations kit, and signaling kit for the same purpose.

The Gibson Girl radio (AN/CRT–3), which automatically operates alternately on 500 kilocycles and 8280 kilocycles, was developed to provide a means for searching aircraft and surface vessels to home on the position of the survivor. This radio, packed in a waterproof buoyant case, by means of a parachute may be dropped from an aircraft to the survivor. The Gibson Girl is carried in multiplace aircraft where it can easily be placed in a life raft when the plane is



Wreck of the Yukon near Seward, Alaska. Search and rescue teams saved many lives in this recent disaster.—Army Air Forces photo.

abandoned. The Air Sea Rescue Equipment Guide, published by the ASR Agency in February 1945, lists some 5,000 items. Since that time many more have been added and the evaluation and improvement of accepted articles is a continual process. All these items were developed through the coordination of Army, Navy, Coast Guard, and Marine Corps facilities and personnel.

Equipment was not enough. Pilots and crew had to be trained to use it. Operational training centers set up schools approximating as nearly as possible tropic, arctic, or open-water conditions. Courses were designed to teach the basic principles of living off the land and sea, principles which might be applied in any part of the world. Emphasis was placed upon individual survival and consisted of information and instruction of techniques and skills which enable men to survive with a minimum of emergency gear until rescued.

The fundamentals taught include:

(*a*) Travel in all types of terrain.

(*b*) Orientation to their situation.

(*c*) Collection and identification of plant and animal food.

(*d*) Location of water and water substitutes.

(*e*) Construction of shelters.

(*f*) Preparation of food, including firemaking and cooking.

(*g*) Knowledge of the biological and physical hazards in the area in which the training is given, and the relationship of these hazards with similar ones in other parts of the world.

To these fundamentals were added the operation of emergency rescue equipment, procedures of ditching aircraft and bailing out, techniques of water survival, adapted skills of hand-to-hand combat and gymnastics, methods of communicating with rescue units and precautionary measures and medical treatment for typical ailments. That these weeks of vigorous training paid off, is shown in the number of men who, when faced with the real thing, lived to fly, sail, and fight again.

Operating methods and techniques were also revised to keep pace with the expansion in transoceanic flying. The function of weather ships, for instance, was enlarged. No longer was theirs merely a job of reporting the weather—they became radio beacons and, when necessary, rescue vessels. They became part of a vast network of stations strategically located in the Atlantic and Pacific. Extensive telecommunications networks were established—utilizing radio, radar, loran. New concepts of coordination and teamwork became the order of the day.

The value of all this research, testing, training and revision is pointed up in the remarks of Capt. Eddie Rickenbacker who, speaking of his own dramatic experience of ditching and survival in an earlier edition of the AIR SEA RESCUE BULLETIN, said, "The story of my own experience as a survivor would have been stripped of much of its aura of stark tragedy had it occurred a year later than it did. Perhaps then, instead of 'seven came through,' it would have been eight. We would not have known thirst. The drinking water kit which converts salt water into fresh water in a matter of minutes, or the solar still, which uses the energy of the sun to produce more than a pint of fresh water a day, would have obviated that. We would not have experienced the terrible hunger, had we possessed the compact, concentrated food kits with which every rubber life raft is equipped today. Nor would we have suffered the exhaustive drain on our physical strength had our raft contained some of the anti-exposure equipment carried today.

"We would not have felt the terrifying mental anguish caused by the fear of 'when' or 'how long' if we had known, as every airman knows today, that rescue would be but a matter of minutes, or hours at most, instead of days and weeks as it was with us . . . or had we the peace of mind engendered by the knowledge of the intricate and efficient operational pattern of planes, ships and men, radio, radar, and all the rest, which comprise air sea rescue today. And added to all these, the knowledge that when rescue did come it would find us fit, that all we had to do was to keep cool and virtually 'sit it out' for a brief spell in comparative comfort."

The record of lives saved is adequate testimony to the success and efficiency of air sea rescue units. In the Pacific, from Pearl Harbor to VJ-day, more than 3,000 airmen of the United States and Allied Nations were saved. In the continental United States area in the period from January 1945 to and including March 1946, 1,032 were saved. Breaking these figures down still further, we find that our West coast sector saved 192 men in 16 months, another saved 99 in 14 months, and in one 12-month period, 452 were saved in the Eastern Sea Frontier area.

Since its inception against a background of war, air sea rescue has experienced an evolution in methods and techniques. Its wartime conception was based upon the urgency of saving men and machines to

Yukon survivors take a last look at their battered vessel as they pull away to safety.—Photo: Oliver Cromwell, RM3c, USCG.

Jungle or arctic . . . the rescue team is trained to operate efficiently in any type of terrain.—Marine Corps photo.

Daytime orange-colored smoke flares help locate survivors . . . one of many important pyrotechnic developments in SAR.—U. S. Navy photo.

carry on the fight . . . it operated in more or less concentrated areas, using all available military facilities such as short range aircraft and boats, destroyers, submarines. In five short years it has witnessed an amazing refinement in methods and equipment. It has acquired a "know how" based on experience which has patterned its operation on an international plane in keeping with the Nation's future program of aviation and maritime development. Today it is a vast efficient network which includes the use of long range planes and surface craft; a well organized communications system utilizing radio, radar, racon, and loran; a comprehensive pattern of ocean station vessels performing an invaluable weather reporting and safety function; and an extensive system of rescue coordination centers which tie the whole together and directs the movement of the air sea rescue team.

Practically all of the nations of the world are including the subject of search and rescue in their diplomatic and commercial discussions . . . not alone

Signaling mirrors saved many lives by attracting the attention of rescue craft.—Coast Guard photo.

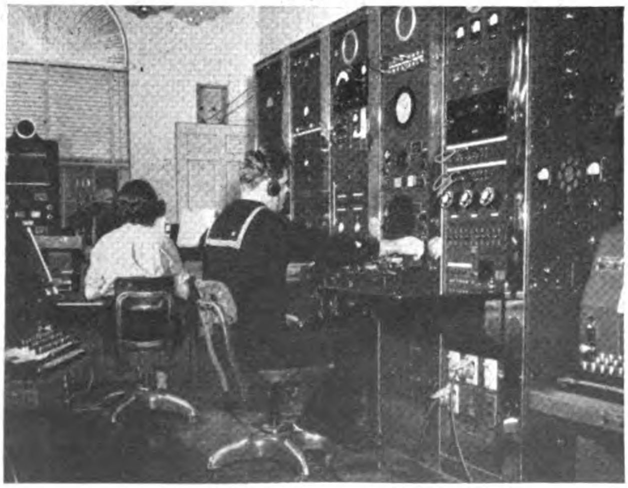
All-weather exposure suits saved many lives by protecting against cold while providing buoyancy and freedom of movement.—Coast Guard photo.

RCAF flyer gets ready to hoist antenna-raising balloon of his Gibson Girl automatic emergency transmitter.—RCAF photo.

The search and rescue team—a Coast Guard PBY-6A and an Army 85-footer—heads seaward on a rescue mission.—Coast Guard photo.

Rescue Control Center keeps accurate track of position of all aircraft and vessels in area.—Coast Guard photo.

Telecommunications—radio, radar, loran—are the heart of the search and rescue control system.—Coast Guard photo.



because it represents an invaluable contribution to the safety of travel on land and sea, but because it provides an important instrument with which to improve friendliness between nations. Nations at peace are ever willing to help alleviate the misfortunes of their neighbors as a gesture of humanitarianism and good will.

It is just a little more than a year since the nations of the world met at Chicago to discuss what cooperative means could be found for developing international civil aviation for the benefit of mankind . . . and just a few months ago the instrument created by those nations, the Provisional International Civil Aviation Organization (PICAO), began to work for the amicable, equitable and orderly development of international air traffic in all its phases.

In broad terms, PICAO has three basic objectives: (1) to create the best physical conditions for civil flying, to eliminate the hazards that arise from a lack of proper organization of air routes or from failure to reach agreement on proper organization; (2) to free international flying from any obstruction or delay of a legal nature; (3) to make international air transport an instrument of good will rather than suspicion and conflict.

The Search and Rescue subcommittee of PICAO is developing a suggested program for the nations of the world in developing the rescue services of the world into a globe-encompassing network that would save many victims of air crashes in remote places along the world's air lanes. It submitted a report of standards it believed necessary for international search and rescue operations. It recognized that while the wartime experience is by no means a fair criterion to apply to commercial aviation, the record of the war-

time years in saving life indicates the importance of having an organized plan for rescue work in advance of the time when the emergency arises. Such emergencies are fortunately rare in civil flying, but civil aviation authorities can nevertheless learn the value of preparedness from the military experience.

The mission of search and rescue is a joint responsibility of all nations and peoples. Further, it is a team effort . . . an operation which, at one time or another, will call upon every type of vessel and plane, plus the ingenuity and initiative of groups and individuals, to assure success.

The merchant ships that ply their trade across the Atlantic and Pacific are part of this vast plan of coordinated search and rescue. Their positions are plotted daily at the naval sea frontier control centers . . . and in keeping with honored traditions of the sea, they stand ready to answer calls for aid from planes or ships in their vicinity. Their logs today contain records of hundreds of successfully accomplished rescue missions.

The scope of peacetime search and rescue widens as world airlines increase the frequency of their transoceanic flights. The resumption of peacetime maritime pursuits, and the development of private flying also step up the ratio of possible emergency incidents.

In spite of man-made safety measures, mechanical failures, floods, and storms will continue to be hazards for the traveler on land or sea. Wartime experiences in search and rescue, however, point the way to greater safety and will stimulate confidence on a vastly larger pattern than ever before.

* * * * *

It will be noted that the term "air sea rescue" and "search and rescue" are both used in this article. The former—air sea rescue—is a term conceived in war and applied to the rescue of survivors from incidents peculiar to military operations—especially combat operations. Further, while the orders and operations plans of military commanders stipulated that aid was also to be extended to the survivors of surface-ship disasters, the term was too frequently interpreted to apply to airmen only.

Thus PICAO, in quest of a more definitive term, adopted "search and rescue." At its North Atlantic Route Service conference in Dublin, it was recommended that the term be defined as . . . "The act of finding and returning to safety the survivors from an emergency incident." This definition is sufficiently broad to embrace the rendering of aid to survivors of civil and military aircraft and ships . . . and where aircraft are involved, it will apply on land or at sea.

A Coast Guard weather ship "rides it out" on station in a heavy sea.—Coast Guard photo.

Showing the unit held in vertical position for use.

handie talkie

(VHF Emergency Transmitter-Receiver, AN/CRC–7).

FOR some time a definite requirement has existed for a compact, lightweight, portable transmitter which could be stowed in an aircraft or in life rafts, and which could be used handily by survivors of an emergency to assist in their rescue. The AN/CRC–7, which was recently adopted by the Army and Navy, is believed to satisfy the basic requirements for such a unit. The AN/CRC–7 is designed to provide tone and voice transmission, voice reception, and a homing beacon. The transmission and reception of signals will provide for communications between survivor and the rescue craft; and tone transmission—employed as a homing beacon—will assist the rescue units to locate the survivor.

Operating on a single crystal-controlled frequency of 140.58 mcs., the AN/CRC–7 is capable of tone transmission in line-of-sight up to 45 miles when received by Army and Navy standard VHF sets SCR–522, AN/ARC–1, or AN/ARC–3. Voice reception of these same sets, as transmitters, is up to full line-of-sight if the transmitter power is adequate. Again, the accuracy of homing on the AN/CRC–7 is dependent only on the homing device which is used.

The AN/CRC–7 is 15 inches long, 2¼ inches in diameter and weighs 3 pounds 12 ounces. When in use, the antenna is extendable to 21⅜ inches.

A combination microphone and speaker is employed, and the switch section and main body are hermetically sealed. The battery compartment is completely watertight.

One of the most desirable features of the 140.58 mcs. frequency is that it is above the atmospheric and precipitation static regions, and is generally unaffected by weather conditions. Extremely high frequencies, however, will not penetrate jungle growth very well. They are also masked by hills, high ocean waves or other obstructions in a manner similar to that of visible light waves.

Tests conducted by the Army Air Forces at Narragansett Bay give pretty fair indication of the possibilities inherent in the AN/CRC–7. A crash boat took position off Rocky Point in Narragansett Bay with two of these radio sets aboard, and a C–47 took off from Quonset NAS with the remainder of the test group party. Two-way communication was immediately established between the SCR–522 VHF set in the aircraft and the AN/CRC–7 in the boat.

The following conclusions were reached as a result of the tests outlined above:

1. That an aircraft equipped with the SCR–522, or equal, and the AN/ARA–8 homing adapter, can home on the AN/CRC–7 signal from a distance of approximately 40 miles.

2. The AN/CRC–7 antenna should be held at, or near, the vertical to assure the best signal reception.

3. The voice level during thunderstorms was found to be high. To reduce it, the tone oscillator of the AN/CRC–7 might be accurately adjusted to 1020 cycles per second, and the range filter used on the receiving SCR–522. Since the use of the range filter may reduce the maximum distance at which the AN/CRC–7 can be received, the filter should not be used until after initial contact has been established.

An aircraft-type life raft was then launched and placed in position several hundred feet from the crash boat. The occupant of the life raft carried an AN/CRC–7. Then, using the AN/ARA–8 VHF homing adopter, the C–47 homed on the signal in such

Close-up showing microphone and operating controls.

a manner as to pass over the life raft. The C–47 then proceded toward Boston in order to determine the maximum range of the set. With the C–47 at 10,000 feet altitude the signal was lost at about 45 miles. Most of the transmission during this period was over land. After losing the signal, the C–47 proceeded at 10,000 feet to a distance of approximately 120 miles before reversing its course. Communication was not reestablished until the C–47 had reached the approximate position where the signal had been lost. Homing on the signal was repeated, this time the AN/CRC–7 being operated from the crash boat.

On the return trip, the ceiling was approximately 1,000 feet and the visibility in the order of 3 to 4 miles. It would have been extremely difficult for the pilot to have located the crash boat by visual means because he did not know its exact position. Several homing passes were made from distances of 5 to 8 miles from the boat with the AN/CRC–7 in various positions.

The AN/CRC–7 and its canvas carrying case.

Angry seas pound the beach at Hilo.—U. S. Navy photo.

TIDAL WAVE HITS HAWAII . . . this was the flashing headline that blazed across the front pages of the Nation's newspapers on 1 April 1946. As is the case in any situation involving a people in distress, the news struck an immediately responsive chord in the hearts of the American people. Yet, almost as swiftly as it happened, the emergency was over . . . and to persons thousands of miles from the scene, it became but a brief interlude in a fast-moving panorama of many important events.

But to the people of Hawaii, the first terrifying impact and the events which followed, remain a moving story of tragedy, quiet courage, and an awesome respect for the overwhelming forces of nature on a rampage.

To personnel of air sea rescue task units in Hawaii, however, it was even more. Here was the test of training and organization—slammed on their doorstep with the speed and force of a battering ram. This was IT—now. No time to refer to the book—no time to pore over charts—no time to "get set." Here's when it paid off with the calm, quiet confidence born of "knowing how"—or missed.

But there was no miss. Hidden in the prosaic, studied reports of the rescue operations lie the answer to . . . sound training, painstaking organization, good discipline, high morale.

The first indication that a tidal wave had struck the Hawaiian Islands, came to the Hawaiian Sea Frontier ASR Control Center when, at 0651, the Haleiwa Rescue Boat Basin reported that two of its 85-foot boats had been badly damaged by heavy surf. A few moments later, the rescue unit at NAS Kaneohe reported a small building had been swept off the beach to sea by towering waves. The rescue controller immediately ordered all ready rescue aircraft into the air to comb and investigate the Oahu Beach area. Their reports indicated that the entire northern coastline of Oahu, from Kaena Point on the west, to Koko Head on the southeast had already suffered varying degrees of damage, and that the situation required that major rescue operations get under way immediately.

At 0809 on 1 April, all available rescue craft—air and surface—were dispatched to search the surrounding waters and bays. Johnston, Midway, French Frigate, and Palmyra Islands were alerted to the threat of the approaching tidal wave. Seagoing patrol craft were dispatched to assist in rescue operations off the northern Oahu Beach area. One PBY from ASR Task Unit No. 2 was stationed 200 miles northeast of Oahu to provide advance warning of possible additional incoming waves. Because communication with French Frigate Shoals and Molakai Island were out, another PBY was dispatched to investigate the situation at French Frigate, and a B–17 from the Seventh Emergency Rescue Squadron went to Molokai with instructions to pay particular attention to the Leper Colony on the north shore.

In spite of considerable damage to rescue craft, the reports which came into the control center at 1030 from rescue units at Kahului, Maui, and Hilo indicated that rescue operations were proceeding smoothly. In response to Hilo's request for additional assistance, two PC boats were dispatched by Hawaiian Sea Frontier, a PBY was dispatched by ASR Task Unit No. 2, and a B–17 with droppable lifeboat, by the Seventh Emergency Rescue Squadron.

By sunset, the entire beach area of Oahu, and for 10 miles out to sea, had been thoroughly searched by air and surface craft and all but one missing person accounted for. Arrangements were made to send three utility wing aircraft and two from ASR Task Unit No. 2 to Hilo at dawn next morning to implement the rescue facilities there. Hawaiian Sea Fron-

tier also put into operation a rotation plan for maintaining two fully-operational PC boats at Hilo, and one at Kahului, Maui.

On 2 April rescue operations in the Oahu area were centered on the immediate beach and along the drift line from Kaena Point in an effort to find the one person unaccounted for on the previous day. An intensive air-surface search was also conducted by ASR Task Unit No. 4 along the northern coast of Hawaii.

Rescue operations on 3 April followed the same pattern as that of the previous day and at dusk, except for purely local rescue activities, the search was concluded.

In the period from 0731 on 1 April to 1800 on the 3d, a total of 515 hours were flown by rescue aircraft. Air and surface craft combined, saved more than 150 persons from almost certain death, and aided an undetermined number of others. One 63-foot rescue craft was lost, another damaged beyond repair. Five others were damaged in varying degrees. A PBY–5A was lost in heavy seas after an open sea landing. Personnel casualties were 2 men slightly injured.

This entire operation was a cooperative effort by the forces of the Hawaiian Sea Frontier, Utility Wing, Seventh Emergency Rescue Squadron, LST–731, and cordinated rescue units. It was a completely successful operation. The final sentence of the official report is prosaic enough. It reads . . . "All participating units exhibited a high degree of skill and cooperative spirit throughout the entire operation."

ASR personnel load a PBY–6A with liferafts prior to take-off at Hilo—U. S. Navy photo.

An ASR PBY–6A prepares to take-off on rescue mission at Hilo—U. S. Navy photo.

Front view of chest-type harness.

Showing two lower points of adjustment.

navy quick-fit chest type parachute harness

FLYING personnel will be interested in the new Navy quick-fit, chest-type parachute harness. It differs from the Navy standard harness now in use in that the adapters have been deleted from the leg straps and the old type snap and **V** ring have been replaced by snap and **V** ring with quick-fit adapters. Also the backstrap has been made into a separate piece terminating at each end in a friction adapter through which the chest straps are reeved. These chest straps terminate at the side of the body just below the ribs.

It is intended that the Navy quick-fit, chest-type parachute and harness will be left in the airplane at all times the airplane is ready for flight operations. The parachute harness shall be adjusted to its full capacity by the airplane captain or parachute rigger as soon as it is placed in the airplane or after every landing. This is accomplished by holding the snap, **V** ring, or adjuster at right angles to the webbing and pulling the hardware.

Flight personnel should don and adjust the parachute harness immediately after boarding the airplane. There are four points of adjustment, one on each leg strap and one on each side of the body located approximately at the lower rib. All adjustments are made by hand. No tools are required. Procedure for donning and adjustment of the harness is as follows:

(*a*) Don the parachute harness in the usual manner.

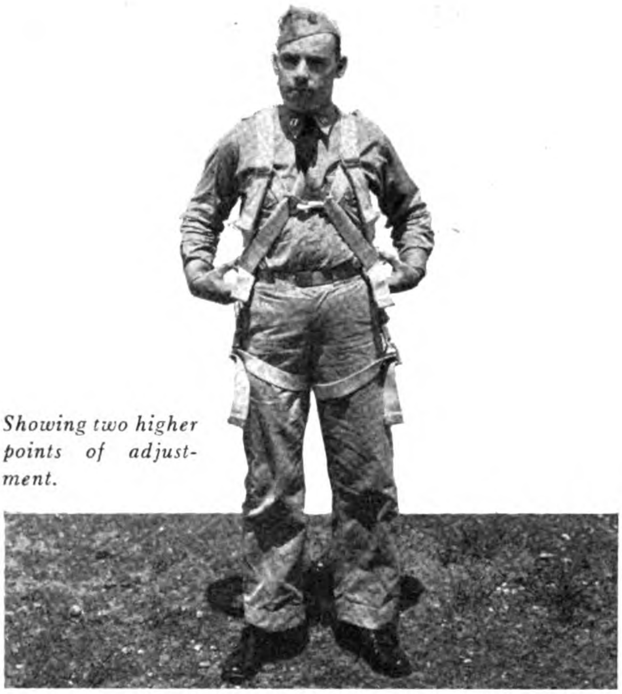
(*b*) Hook up the chest straps and leg straps.

(*c*) Pull the leg strap tab ends downward until a suitable snug fit is obtained.

(*d*) Pull diagonally upwards on the chest strap tab ends, until a suitably snug fit is obtained. This operation removes all slack from the chest and back straps and removes any remaining slack from the shoulder straps.

(*e*) If desired, the loose tab ends of the chest and leg straps may be tucked under.

The harness may be loosened for comfort during flight if desired. This is accomplished by tilting at right angles to the webbing the snap and **V** ring on the leg straps and the adapters on the backstraps and pulling thereon. Do not unsnap the harness attachments. It is emphasized that there may be insufficient time during emergencies to properly readjust the harness prior to bail-out. For this reason, loosening the harness should be kept to a minimum and it should never be loosened to its full capacity. Serious injury may result to flight personnel bailing out with harness fitted too loosely.



Showing two higher points of adjustment.

The quick-fit hardware operates on the friction lock principle. When pull away from the hardware is exerted, the sliding bar, around which the harness webbing is reeved, moves to the rear of the hardware, locking the webbing between the sliding bar and rear bar of the hardware. The quick fit hardware has been dummy-drop tested and live jumped and has successfully passed all requirements.

Since the quick fit chest type parachute harness must remain adjustable at all times in order to properly fit both large and small flight personnel, temporary tacking to the parachute harness, which will restrict adjustability, must not be used. The only position on the harness which may be tacked is the chest snap and **V** ring. It has been determined that by tacking the chest snap and **V** ring on and body straps 6 inches below the fixed shoulder adapters that a position to properly fit all size personnel is obtained.

Procurement of quick-fit hardware has been initiated and deliveries of this parachute harness is anticipated during the second quarter of 1946.

Particularly valuable to Personal Equipment Officers, is the Air Forces' new *Reference Manual for Personal Equipment Officers* (*AAF Manual 55-0-1*). Prepared by the Personal Equipment Laboratory, Wright Field, it is a practical reference manual sufficiently broad in scope to be of interest to all military flying personnel.

POLE LITTER CARRYING STRAPS

From the Naval Medical Research Institute comes the design for a simple, inexpensive strap for helping litter bearers to carry their burden more easily. It is a cotton tape 1/16-inch thick by 1½ inches wide by 98 inches long. In the absence of such material the tape can be made of a strip of canvas 6¼ inches wide by 98 inches long. The canvas is folded into four thicknesses and sewn. In making the carrying straps from either the manufactured tape or canvas strap, the following steps are taken:

1. Make a single loop on one end by folding back 6¾ inches and sewing down 2¼ inches. This leaves a loop of 4½ inches.
2. On the opposite end fold back a loop 23¼ inches and sew down 2¼ inches. Sew down three 1 inch sections. This leaves four loops of 4½ inches each. Hot wax can be applied over the sewn surfaces if desired. This will seal the stitching and prevent the 1 inch sections from absorbing water.

This strap is not designed to supplant the use of the arms in carrying the litter, but to afford the bearer a chance to rest his arms completely or to take at least a part of the litter weight off his arms. In rough terrain the weight can be borne by the straps thus leaving the hands free to allow the bearer to balance himself better and steady the patient on the litter.

The four loops in one end of the strap eliminate the use of metal buckles and fasteners that would tend to deteriorate in moist climates, and allow the bearer to fit rapidly the handles in a loop commensurate with his arm length. The straps are light and flexible and can be carried in the pocket or belt when not being used.

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FIDO

fog intensive dispersal of

Commander Robert L. Champion, the Navy's No. 1 expert on fog control, is a 32-year-old ex-engineer turned sailor. Graduate of the University of Illinois, and a former instructor in electronics at Northwestern University, Champion discovered that by atomizing gasoline before burning it, he could cut through a fog blanket 3 feet thick in 10 minutes. It all started when he was stationed on Attu and had to devise a way for planes to land on islands which were covered by fog for three months of the year. Commercially practicable, his method will soon be available to the world's commercial air lines. Champion's most exciting experience took place while ferrying the late President Roosevelt to Adak in the Aleutians. A thicker fog than usual blanketed the islands and bothered the antisubmarine patrol planes which were on hand to see that the President's ship was not torpedoed. However, Champion's fog dispersal equipment performed perfectly and the President got safely through.—Ed.

IN spite of the magic fingers of radar and other electronic aids, fog continues to be the airman's No. 1 enemy. Being the foggiest naval air station in the country would ordinarily be a liability rather than an asset, but NAS ARCATA has capitalized on its worst feature and become the center of a highly important experimental program of fog dispersal.

NAS ARCATA is situated about 300 miles north of San Francisco on a bluff rising abruptly 200 feet from the ocean—a situation which contributes to the high incidence of fog over its runways. Since other factors were satisfactory, and the fog was certainly available—thick, juicy, dependable fog—this station was selected by the Navy in late 1944 as the Landing Aids Experiment Station for continuing the fog-dispersal work pioneered by the British and first used by the United States in the Aleutian Islands area.

FIDO—meaning Fog, Intensive Dispersal of—proved its value in the British Isles during the war when, despite soupy weather, fog-bound fields were cleared to permit the take-off and landing of bombing missions. Through holes cleared by the heat from gasoline burners outlining the runways, hundreds of bombers which might otherwise have been lost were brought down safely. The cost of the gasoline burned—$4,000 to $5,000 to land one plane—was heavy, but well spent. In fact, FIDO became so valuable in landing bombers returning from missions over Germany that at least 15 bomber command fields were equipped with fog dispersal systems.

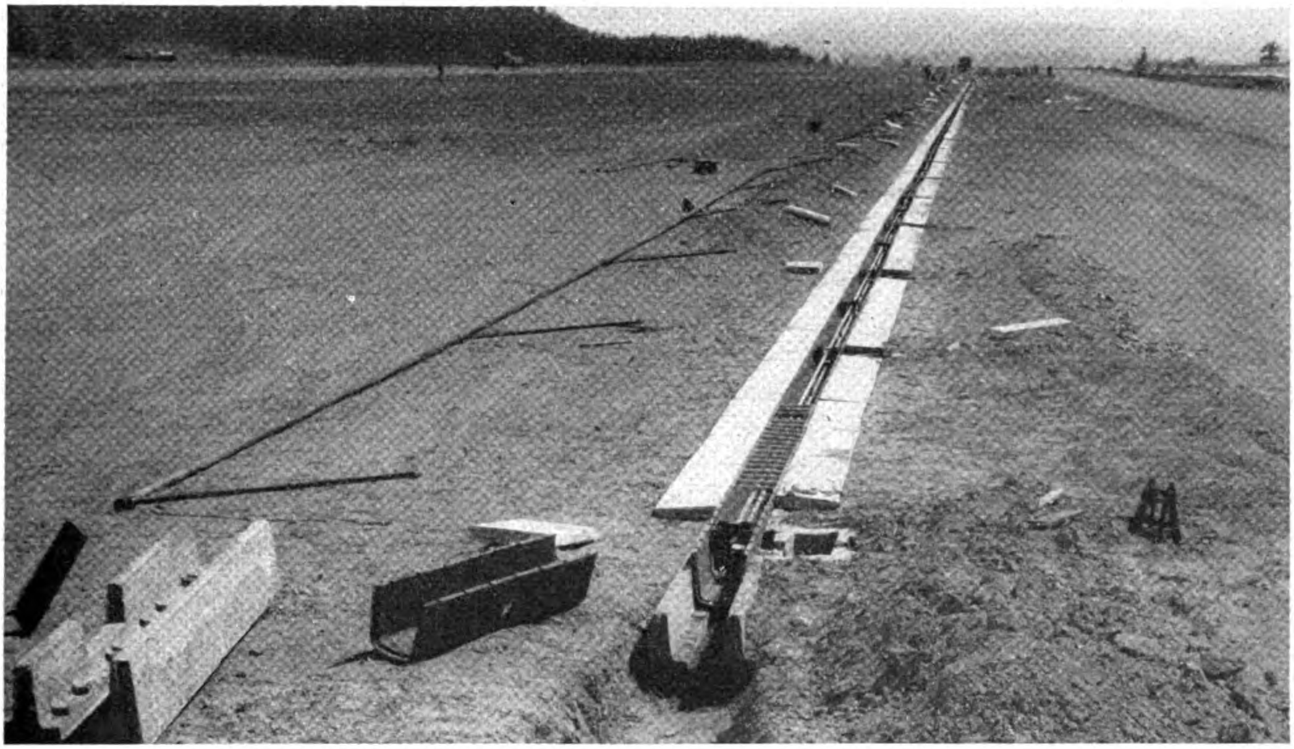
The Navy's interst in the system was primarily centered in the possibilities for its use in the Aleutians area where bad fogs prevail in conjunction with moderate to high wind conditions. Following a survey of all military fields in the area, it was decided to make the first installation on the Army Air Base at Amchitka. Work was started on the project early in 1944, with Seabee personnel installing the equipment. The nature of the terrain posed many tough problems. Enormous amounts of tundra had to be moved to provide the burners with a firm, level foundation. It was necessary to drive special supports through the tundra

to rock strata in order to carry the burners over small ponds and uneven ground. The burners, which were based principally on British design, were constructed on the site—100 of them being turned out in a brief 5-day period.

The first aircraft landing to test the FIDO installation at Amchitka under zero-zero conditions, took place in July 1944. Burners were lighted just before dawn, and within about 10 minutes the area over the runway and downwind of the burners was completely cleared of fog and the sky was visible. Taking off in a 15-mile crosswind, a PBY–5A took off and disappeared in the fog after passing the limits of the burner line. The plane then made a normal instrument letdown, and broke out in the clear at about 150-foot altitude at the downwind end of the runway. This operation was followed by two successful take-offs and landings by an Army C–47. Both pilots agreed that the landings could not have been made without the use of the fog dispersal equipment.

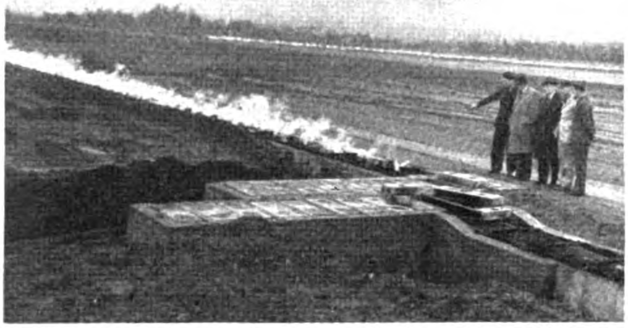
In the fall of 1944, the equipment at Amchitka was used tactically for the first time when, in spite of the heavy fog prevailing at the time, six planes were launched, with FIDO's aid, in order to form an antisubmarine screen for President Roosevelt who was then in the Adak area.

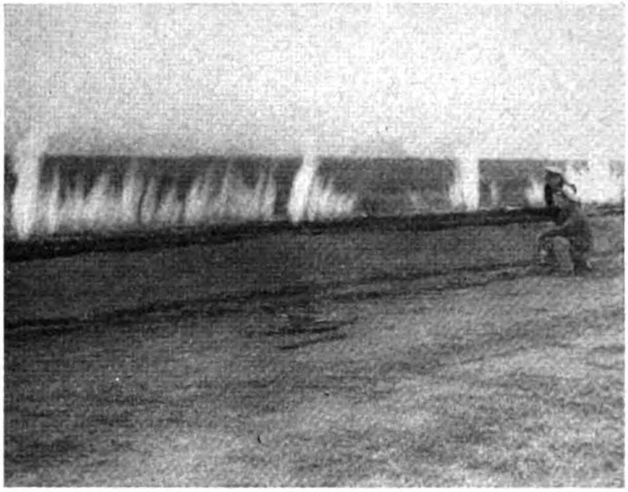
Although the cost of operating the FIDO equipment, as used in the British and Amchitka installations, was insignificant when evaluated against the crews and aircraft which might have been lost under zero-zero conditions without it, much remained to be done to refine the equipment and to develop better burner efficiency to cut the expense of fuel. The basic importance of the project warranted further experimental work, both on different types of burners, and on fog dispersal methods other than thermal. This need resulted in the establishment of the Landing Aids Experimental Station at Arcata.



Slot-type burner which gives 10-minute burn on 2,500 gallons of gas.

When this station was first set up, the war was still in progress, and the immediate aim was to develop the best possible equipment for fog dispersal for installation on the islands north of Japan to assist the aircraft operations in that area. With the war pressure removed, experimental work was continued, and it is significant that progress of the program has been watched and participated in by the Army Air Forces, Royal Air Force, British Petroleum Warfare Department, Royal Canadian Air Force, the National Development and Research Committee, the Civil Aeronautics Administration, and many leading universities who have contributed through research projects.





Different types of burners tested at Arcata to obtain most effective clearance at lowest cost.

The dispersal of fog over airfields is obviously of great importance to military and commercial aircraft operations. The earlier problems of economical operation is rapidly being eliminated. So much so that it is estimated planes can presently be landed on fog-shrouded fields at a cost of from $100 to $200, figuring 10 minutes per plane and, at a busy airport with a heavier traffic flow, costs can be reduced still further.

The job of thoroughly developing and testing low-visibility landing aids calls for a wide variety of research and installation at the experimental station. Aside from the thermal systems which form the backbone of the work, the field is also equipped to test many other landing aids; sonic, wind curtain, water screen, high-intensity lighting, radio.

Since most of the fog dispersal systems based on the heat method were pioneered by the British, it was decided to install the most effective of these at Arcata for use as a yardstick for evaluating new equipment under development by various agencies.

Thermal installations include the "slot" burner, one of the latest designs used operationally by the British, and also installed at a commercial field near London. A Hades-Rapex installation, providing the highest thermal output of any burner system, is also in operation, as is a modified Haigill system using Navy, Army Air Forces, and British experimental designs.

The "slot" type burner (USN MK–5) consists of two 1-inch pipes, one above the other a few inches apart. Gasoline feeds through the top and, at the end of the line, makes a **U**-turn back into the bottom pipe. The lower pipe is drilled with regularly spaced holes through which gasoline feeds out and burns. This heats the gasoline above until it becomes a vapor and creates pressure. In a few minutes enough pressure is produced to shoot flames about the height of a man. Fuel consumption for 10 minutes of operation is 2,500 gallons of 60-octane gasoline at a cost of 6.7 cents per gallon.

The Hades-Rapex burner (USN MK–3) has 16 vaporizing tubes feeding into a collecting pot. From this pot the gasoline vapor is fed into a single 8-inch burner pipe, under intense pressure. When ignited, the pipe throws off an extremely high temperature.

The most promising improvements being made to cut costs and increase efficiency, are along the lines of atomizing fuel by high pressure instead of heat. This method involves no smoke and no waste, and may be operated with gasoline, kerosene, or Diesel oil. Various types of burners developed to use cheaper fuels by the National Development and Research Committee, British Petroleum Warfare Department and others, are also being tested.

At Arcata, automatic control of installations has been arranged so that an operator in the control tower can, by pressing a couple of buttons, ignite more than 2,000 feet of burners, thus lining the runways with banks of flame. At the same time, experts on the field gather data on the experiments. The type of fog, size of fog particles, dew point, temperature, temperature of the ocean water, wind velocity, barometric pressure—all are recorded. An amplifier on the control tower permits men in the tower to talk with those on the field. Walkie-talkie units are also used for this purpose.

Among the nonthermal systems being tested, the sonic method has created considerable interest. It is based on the principle of changing fog to rain by high-

frequency sound wave bombardment. Sound waves bounce the particles around, causing them to meet and merge, thus forming units large enough for precipitation as raindrops. The equipment consists of a series of powerful, air raid type sirens with 24-foot wooden horns to direct the sound. Sound wave fog dispersal, if it can be effected with more easily portable equipment, has practical potentialities for aiding carrier-based aircraft. Present investigations may lead to developments which will allow carriers operating in fog-bound waters to improve their own weather conditions.

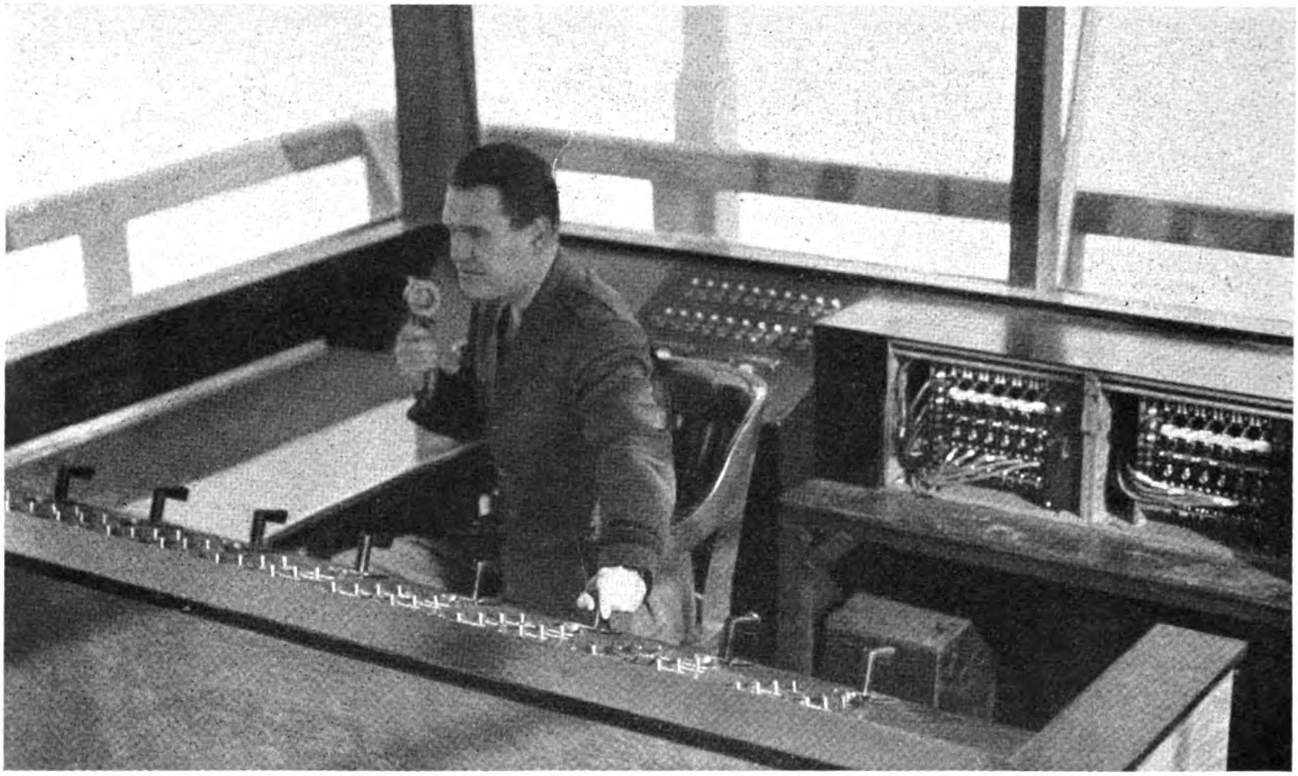
The wind current method offers still another promising phase. With a cross-wind blowing on the runway, a huge blower throws a curtain of hot air at right angles to the wind. This causes the wind to move in a vertical circle, thus dispersing the fog.

When we consider the advances which have been made in automatic controls for piloting aircraft, it might be supposed that full instrument landings would obviate the need for a fog dispersal system. Low-approach equipment and navigation aids will bring a blind aircraft safely down within 50 to 100 feet of the runway, but from then on the pilot wants to know and see what he is doing. Even if full automatic instrument landings do become a practical reality, the actual and psychological benefits which come of the pilot being able to see that everything is cleared for the ground contact, will still make a certain amount of fog clearance highly desirable.

Since the use of radio glide and localizer beams to direct the automatic pilot will line the aircraft up with the runway, fog clearance need not be as extensive as those provided by the test burns. A ceiling of 200 to 300 feet should be adequate. The landing aids at Arcata include "sliding" beam apparatus used to supplement the work of the weather fixers, not as a substitute for it.

A typical FIDO test flight report indicates the results being obtained at the experiment station. The field had zero ceiling and visibility when the burners were ignited. Five minutes after ignition, ceiling was 1,000 feet near the center of the runway with good visibility the full length of the installation. The plane, a PBY 4–1, took off from a cleared runway, but as soon as it passed the last burner it entered a zero-zero bank of heavy fog. The fog was topped at 2,700 feet over the ocean and gradually rose to 3,500 feet over land . . . and FIDO burned a hole completely through it. Landing was accomplished with use of

Home fires burning through fog aid in saving lives and aircraft.



Operator at central controls electrically ignites more than 2,000 feet of burners at Arcata.

the radio range station and SCS–51 approach gear, the runway becoming clearly visible at ½ mile and 100 feet. However, the ground could be seen from 150 feet and about a mile from the runway. The dispersal was caused entirely by the FIDO operation, the surrounding area still being zero-zero visibility and ceiling.

The pilots who made this test run expressed complete satisfaction with the FIDO operation. They reported they noted no undue turbulence or floating, and that the use of flame in the operation presented no mental hazard once the pilot had seen it in use. On some of the test burns, the cleared hole was large enough to permit aircraft to circle the field and land entirely by contact. When modern approach gear is used, just a few minutes of heat will provide enough ceiling to care for almost any situation.

Man's control over nature in these experiments is, of course, only a temporary victory . . . achieved for the needed period of time then lost again. Lest man become too enamored of success, the elements immediately revert to their former status, as witness this situation reported in a test burn:

At 0945 one morning, visibility was $1/16$ mile, ceiling 50 feet, temperature 53° F., humidity 100 percent. The burners were ignited and at 1015 the sky became visible through a thin strata, with a variable ceiling of 800 feet. Visibility was good over the entire length of the installation. An hour after the burn started, the maximum surface temperature of 66° F. was reached, and humidity had dropped to 66 percent. Large portions of sky showed through the 1,700-foot depth of fog. Then the burners were turned off. About 15 minutes later the ceiling had lowered to 100 feet, visibility was down to ⅛ of a mile instead of the full length of the installation, and humidity had gone up to 94 percent.

When the Navy made public its program at Arcata, the importance of the project to an air-conscious world was reflected in the interest evidenced by the newspaper and magazine press throughout the country. The commercial air carriers, recognizing that the closing of one or two key fields will quickly disrupt the schedules of an entire system, are watching the experiments closely. Just as the progress up to now has resulted from the combined efforts of the Army, Navy, British, and civilian research activities, so will the benefits deriving from the work of Landing Aids Experiment Station accrue to all whose business it is to achieve the maximum of safety for aviation—military and civil.

the rubber boat, friend and fighter

Because we started out to obtain it at a pretty late date, the only biography of Lieut. Colonel Maynard M. Nohrden available at press time was . . . that he is a colonel in the United States Marine Corps. Yet, thinking it over, what more of a biography does a man need.—Ed.

THE rubber boat has likely destroyed as many enemies as it has saved friends. Such a doubled weapon can scarcely be found in any other category of the armed forces, unless it is in the amphibian tractors LVTs or the Dumbos PBYs.

The commanding general of the First Marine Brigade predicted in 1940, at the final critique of Fleet Landing Exercise No. 6 at Culebra, P. R.; "The rubber boat is here to stay. It is a new and effective weapon." This craft had just surprised many amphibiously trained officers and men with its deft ability to go places and do things under conditions prohibitive to ordinary boats. It had appeared from behind breakers coming into the beaches and disappeared just as easily in the brush to the complete consternation of its opponents. Six inches of water or 6-foot breakers over a coral reef were taken in stride by this little craft. Quickly inflated for use, easily deflated for concealment or stowage, it put a new complexion on the face of small boat usage.

Like the amphibian tractor this craft was conceived of Mercy rather than Mars, having been designed as a

lifesaver for use under special conditions. One of the first jobs accomplished by this collapsible pneumatic boat was as a standard piece of equipment in many of the larger naval seaplanes in the thirties. This little yellow bundle of insurance became a very conspicious passenger aboard many of the large flying boats as it faithfully stood guard over the lives of the plane's crew and passengers, and indeed it is to this very odd blob of fabric that many a flier today owes his very existence and continued ability to fly. Whereas, the air services have spared nothing in their policies and efforts toward an extensive air sea rescue program, it is upon this simple rubber keystone that much of the life saving work directly depends. The use of this boat as a life raft aboard surface transports is extremely expedient in that it can be carried in a ready condition for simultaneous launching and inflation by the pull of a single release toggle. It is almost foolproof due to its flexibility, while its bouyancy is far in excess of requirements.

This rubber "raft" was originally a very unpredictable, vulnerable and temperamental item upon which many of the early skeptics looked with much doubt. In its early form, the development of the rubberized fabric for the hull left much to be desired in respect to durability, strength, and ruggedness.

The reliability of the automatic CO_2 inflation system was subject to the vagaries of weather, trial and error and that ever unknown factor, the human equation. The boat was treated as are most neophytes. The lack of respect for this little craft is indicated by such appellations as the "doughnut" as applied to the one-man variety and the "beautyrest" reference to the larger three-to-seven-man sizes. Having won several important innings in the game of rescue, however, critics withdrew some of their earlier skepticism and observers decided that with some grooming, development and training, the rubber boat had definite possibilities for a post in the important positions.

Design engineers, research men and aviators were put on the job of development, experimenting, and testing. Their inventiveness, ingenuity, and practical efforts ran the gamut of imagination in fitting out these little craft. The correct combination of rubber and fabric for the hull had to be arrived at; flexibility, lightness, and durability were required for ease in packing, stowing, and breaking out; foolproof inflation systems were aimed at, while the controlling dimensions and the incidental equipment occupied the minds of the engineers who had to compromise between the necessary and the desired. The craft had to be capable of long periods of storage, it had to resist deterioration due to the variations in climate; it had to possess the qualities of a "minute man." Such refinements as a sun awning, solar evaporator, and a "complete" fishing kit were added, while improvements in auxiliary hand air pumps, patching gear, sea anchors and bailing buckets were cleverly devised, all in a waterproof rubber envelopes attached to the boat equipped with a corrosion resistant zipper opening.

Introduction of a seven-man rubber life raft to Marine Corps aircraft brought the attention of personnel in this arm to the possibilities of employing its flexibility in the various phases of landing operations. Experiments in tactical use of this craft were made at several Marine bases. As alterations were made to strengthen fabric and basic construction, general rather than emergency use of the craft took shape and promised permanency of character. Amphibious experiments were conducted for the new LCR (Landing Craft Rubber) as early as 1939 with the U. S. S. *Manley*, an APD (ex-four stack destroyer) in the Quantico and Virginia Beach areas, thus working both personnel and craft under actual water and beach conditions. This afforded the first practical opportunity to iron out personnel and material wrinkles.

Development of the rubber boat from a tactical angle was now in order. From an embryo rubber float, balloon-like and extremely difficult to maneuver, the craft was stiffened by a higher gas pressure inside a stronger casing to emerge as a landing weapon, compact and handy. Sharp aluminum paddles were replaced by a detachable wooden type; the automatic CO_2 inflation system was perfected; a triple strong bottom was installed for protection against coral and sand chafing. With these changes the 7-man emergency rubber life boat began to take shape as a 7-man rubber landing boat vested with strange, but potent peculiarities and potentialities.

Deflated and rolled in its case, this craft appeared as a slightly over-sized sea bag, the CO_2 flask weighing about 4.5 pounds being integrally included. To be put into operation, it was necessary only to un-zip the carrying case and open the CO_2 valve. In 10 seconds the boat was inflated and ready for water use. Convenient lifting handles for carrying were provided; grommet type row-locks, conveniently placed valves for hand-pumping additional air, and of course, the first comfortable thwarts ever designed were installed. The outstanding tactical addition was the clever design of a curved machine gun base plate which would fit on either bow. This was of a stainless steel or duralumin fitted with securing

straps which tied in with eyes strongly reenforced to the hull fabric. A .30- or .50-caliber machine gun of standard design could be readily mounted and fired from this adapter. It is interesting to note, however, that the recoil reaction of the gun firing propelled the boat astern about 2 knots which was just about the average forward speed attainable by paddling. By the same design, there was adapted an outboard motor mount complete with a small transom, measured to take the motor brackets. The problems resulting herein were many. Lack of rigidity of the boat permitted the screw thrust to buckle or bend the entire boat amidships; the tendency of the screw to "run under" the stern bent the entire stern tubing so that the after wash nearly swamped the craft. These and many lesser problems were solved with only the tedious study, trial and error methods that design and testing personnel never advertise. This produced the first LCR possessed of most of the characteristics of a regular surf landing boat, and many more of a valuable tactical nature.

The final step in development produced our present 10-man rubber landing boats, possessing the advantages of the smaller craft, plus greater capacity. The new boat was provided with a special pneumatic flooring, not unlike a rubber mattress, which added stiffening and buoyancy. This prevented buckling when under tow or own power, added buoyancy, increased the capacity and safety factor. The motor was protected from a following sea by a rubber-fabric canopy fitted to a tubular frame over the motor. A high bow and an antispray fender around the entire craft was added to keep personnel as dry as possible. This boat has been towed fully loaded at 25 knots.

The "hull" was developed by a major rubber company into a very strong rubber-impregnated fabric which possesses the combined qualities of flexibility and strength, covered with pigmented cement and coated by a long-baking process, the surface is impervious to water, wears well, and resists the combined deteriorating effect of sun and salt for a long period of time. The boat was sectioned into 11 separate compartments, the main elliptical tubing divided into 2 horizontal compartments, while each of the 3 thwarts represents a separate entity. The flooring is divided into 4 parts and the 2 antispray tubes complete the divisions. Each compartment is equipped with a non-corrosive valve for hand-inflation. The large 10-man boat is 15 feet 7 inches long and 7 feet 3 inches wide, while the main tubing is 18 inches in diameter. The maximum height from the bottom is about 30 inches, due to the upturn of the bow.

Embarking, towing, and paddling represent the three phases of training in use of these boats for amphibious operations. Each man is employed in all phases of the use of the craft, for he is a paddler and a fighter. The boat can be consistently paddled at about 2 knots. Wind has a great effect on the progress of the craft. Use of the outboard motor, or towing can effectively be executed at 4 to 8 knots depending on the size of the motor or tow and the conditions of wind and sea. Boat discipline is of great importance in these specialized craft. Each man must know what to do, when to do it, and how, without directions at the time of actual landing. Practice in embarkation and debarkation from a transport is necessary to perfect the personnel in this important phase of landing. During initial training the men are usually divided into three groups, each rotating through these three phases.

For embarking, boat personnel are issued all necessary gear well in advance of embarkation, whether from a ship, submarine, or plane. They are disposed so as to be as near the rubber boat launching point of the transport craft as possible. Rifles are bundled so as to present an easy load for lowering and securing in the boat. Paddles are temporarily bundled for lowering into the boat. All hands wear life jackets over the packs. If a machine-gun is taken, it is broken down into a three-man carry and handled by its crew.

The rubber boats are thrown overboard and hauled alongside by the bow and stern lines, whereupon embarkation takes place at a rapid rate. After being loaded, the rubber boats proceed to their designated power boat to rig for towing. When the boat groups are formed, the power boats with tows of 2 to 4 rubber boats, proceed to the rendezvous area, and await signal from the guide boat to proceed in formation to the line of departure. Tows approach within 500 to 1,000 yards of the beach where by means of automatic release hooks, the rubber boats are freed from the towboat and then proceed to the beach under their own power—either by paddles or by quiet outboard motors.

One portable radio receiver-transmitter is usually carried in the guide division boat for communication with the ship to report emergencies or information, and also to receive any necessary coaching. In the stern of the towing boats is carried a blinker tube and blue stern light for position purposes.

Tactical surprise is the forte of this craft, and since it can land practically anywhere it will effect a landing on the beach least likely to be defended. Its flexibility for use from aircraft has already been ably

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demonstrated. From submarines, ship, or shore, it makes reconnaissance, or landing in force possible against natural barriers almost insurmountable for the average boat. As a reconnaissance weapon, it is almost unsurpassed in surface vehicles and in short, it is becoming a jack of all landing trades

But this Janus-like friend while smiling with a friendly smile on the one side was found to wear a far different expression on the other. It was a martial expression which indicated an ability to wield the sword. Quick to plumb the offensive possibilities of this craft was the United States Marine Corps. A careful development program was launched to adapt it for use on intelligence missions, raids, and even with full-sized assault units, which later became the Marine Raider Battalions. Presto-like, this lifesaver had become a life taker, cunning and ingenious—capable of negotiating rough water, shallow-water, reefs, and surf. It was difficult to detect due to its low silhouette and hence difficult to hit with small-arms fire. It was capable of landing on any section of a beach, and equally capable in withdrawing therefrom. They were usually launched from submarines at night, or from small assault surface craft, just off a hostile shore. If an intelligence mission was assigned, the boat was usually paddled silently into the enemy beach, deflated, and hidden while the scouting and gathering of information was in progress during the daylight. When darkness covered the movement, the reverse process was effected. On an assault mission where surprise was a key element, these craft were usually propelled by their motors to a point just outside the reef or breakers from where the paddles were used for the final spurt. Machine guns and radios, well waterproofed, were in constant readiness for use either afloat or ashore, being rigged with special amphibious adapters for such bilateral use. The rubber raft had become a fighting craft.

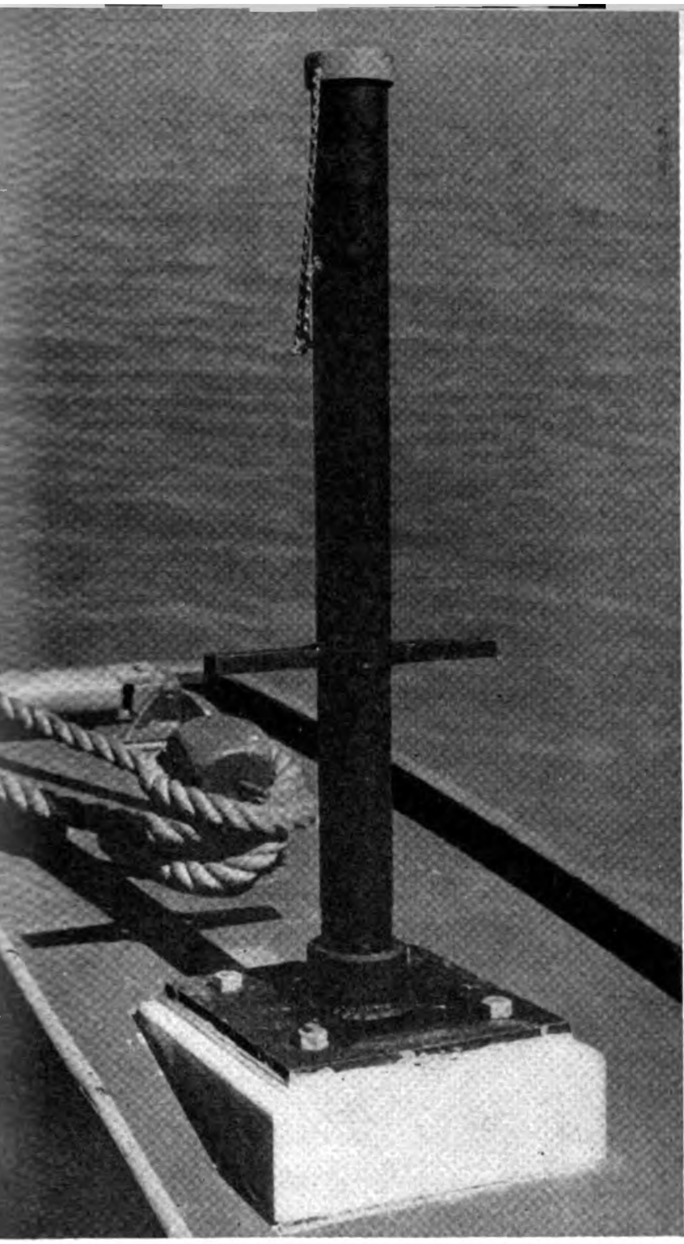
In 1943, the Army Air Forces conducted a series of "exposure" tests in these rubber rafts with volunteer crews, as observation boats stood by to take data, readings and photographs of the experiments and also to render immediate aid or rescue to any of the men who might appear to have gone beyond a safe limit of endurance. Simultation of South Pacific conditions were effected and the data obtained were later used to great advantage in subsequent improvements on the rafts which today accompany our airmen to every corner of the globe. The great tests, however, were those of emergency, with life and death; herein the rules for the rubber boat were written in the blood of men, as are most other safety rules.

The use of the rubber boat in its various forms in air sea rescue are beyond account. The extreme strength built into this craft as a fighter was equally adaptable to use as a savior. There is no more spectacular and successful lifesaving maneuver than the air-drop of a rubber boat from a rescue plane at sea. The highly developed system permitted of unbelievable extremes in perfection so that the precentage of lost personnel reached the vanishing point, as compared with lost planes that had been downed.

Basically the system involved the prearranged preparation of air sea rescue planes, usually PBYs, coded as Dumbo planes. These carried the rubber boats completely equipped as heretofore described with such additional items as a two-way radio, smoke pots, and numerous streaming life lines, emanating from the small boat. On emergency call or even anticipating them, in following up a long overseas hop by large numbers of tactical planes, these Dumbos would answer radio calls immediately as directed, spot downed aircraft and personnel, and make their rescue in any of several ways. In the event of permissible sea conditions, the Dumbo could land and pick up survivors, otherwise the old faithful rubber boat was dropped upwind, automatically inflated, and positioned so as to drift down on its intended passengers. The smoke pot which has been actuated in connection with the boat enabled easy location by the survivors, the streaming life lines helped them to catch control of the boat and pull themselves to it. The record of aviation personnel brought back to fly again by this ingenious device is almost unbelievable.

One other unadvertised, but indirect life saving mission of the little rubber craft, was its employment by the great Underwater Demolition Teams of the naval service. These groups used these boats in stealth, silence, and darkness, to destroy submarine defenses of the enemy on many a shore marked for invasion by the United Nations. This insurance policy undoubtedly saved inestimable lives on every advance made against a beach.

"Love Charlie Roger" was now a fighting boat in its own right and was adopted by all the arms of the services of the United Nations. Ground forces used it for river crossings, air forces for life saving, service forces for emergency supply work and pontoon bridges, while the amphibious forces used it for assault on otherwise unapproachable islands and shores. It was a craft adaptable to many uses, in many fields, and climes, and is today, having finished its work against aggressors, continuing its efforts against the elements in the cause of safety.



Showing the complete projector assembly on boat deck. Reinforcement below deck was necessary for added strength against recoil.

high altitude parachute flares

A HIGH-ALTITUDE parachute flare and flare mortar—designed to illuminate seaplane landing areas at night, to permit aircraft to land on the water at night within a marked channel, or to locate an island base when low ceilings do not provide proper visibility from normal flying levels—has been authorized for installation on all Coast Guard 63-foot rescue vessels. The Coast Guard's naval engineering section is also planning to install them on all 110-footers.

In the past, night search missions have been aided by parachute flares dropped from aircraft. However, such night searches were handicapped by the inability of aircraft to carry a sufficient number of flares for extended search, and were obliged to return to home bases for additional flares, or to request relief by other aircraft. It is expected this high altitude flare will eliminate those disadvantages.

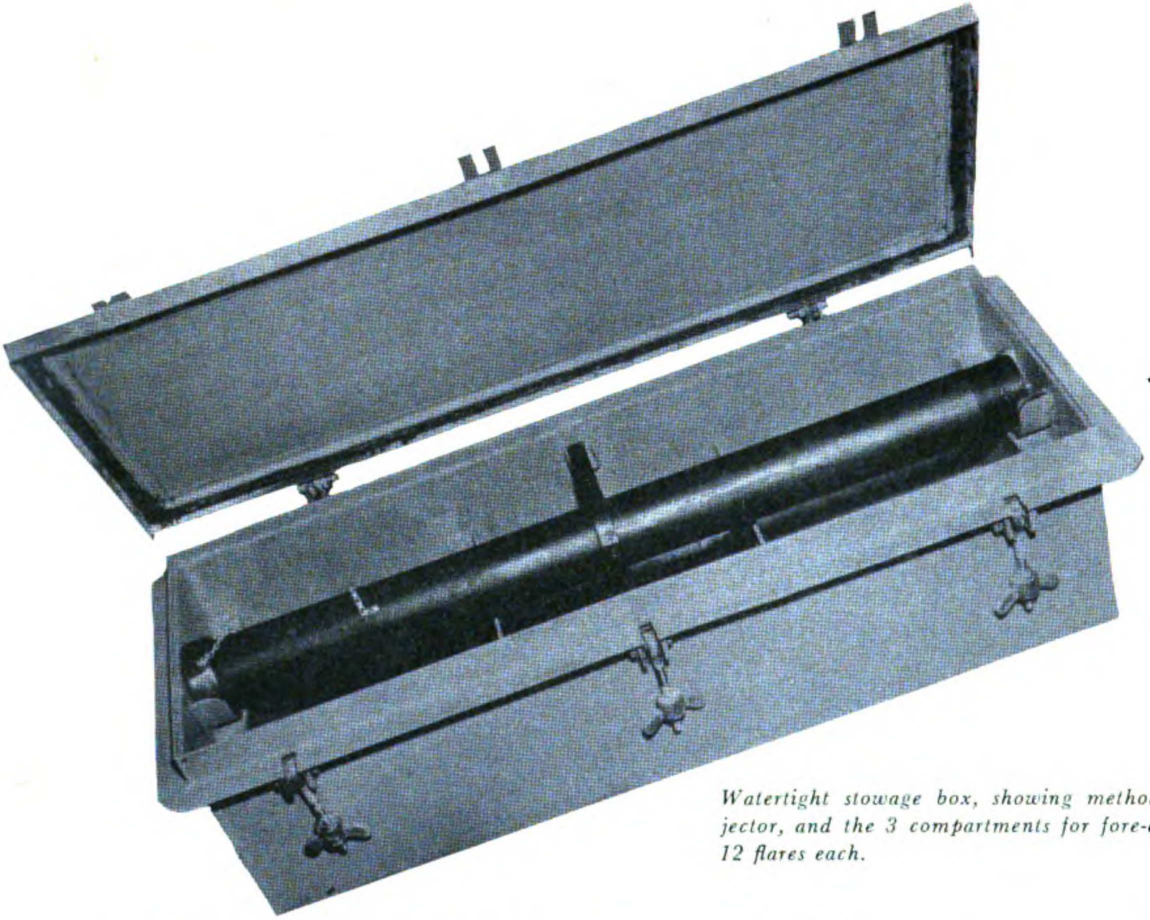
The complete flare weighs about 5 pounds and is in the form of a cylindrical steel tube with a copper cup welded to the closed end of the tube. The over-all length of the signal is 10¾ inches and the diameter is 2½ inches. The flare body, with the copper cup welded to it, contains a parachute, the pyrotechnic candle, and the expelling charge. The copper cup contains a standard shotgun primer, the propelling charge and the fuse assembly. The propelling charge consists of 25 grams of a combination of smokeless and black powder.

The mortar is a steel tube which screws into a base plate. The mortar tube is 36 inches long and 2.8 inches in outside diameter. The steel base plate is ¾ inch thick and 12 inches square. Four holes are drilled in the base plate for attachment to a concrete base, or to the deck of a boat. The base plate is provided with a central stud into which a hardened-steel firing pin is pressed. Should it become necessary to replace the firing pin at any time, the stud may be easily removed with a socket wrench provided with each mortar. The base plate is also drilled with three vent holes for the dual purpose of providing means to vent air from the tube to permit the flare to fall freely against the firing pin, and to provide a drain for any water that might enter the tube.

The upper end of the projector is drilled transversely to receive a release pin with a 30-foot lanyard attached, for the purpose of supporting the flare prior to firing. Each projector is provided with a brass closing cap to exclude dirt and moisture.

The signal, after being dropped down the mortar tube, will be propelled to a height of approximately 1,000 feet. At the apex of the trajectory, the pyrotechnic is expelled and burns with a white light of 85,000 candlepower. The burning time is about 60 seconds, during which time the flare and parachute descend at the rate of about 6 feet per second.

The mortar may be mounted on the beach adjacent to the landing area, or on a boat deck. The base plate should be mounted on a rigid base, preferably concrete. In any event, whatever material is used as a base, it should have a channel approximately 3



*Watertight stowage box, showing method **of stowing projector, and the 3 compartments for fore-and-aft stowage of 12 flares each.***

inches wide running directly under the vent holes in the base plate in order to vent the trapped air.

The mortar should be mounted at an angle of 15° from the vertical, in order to minimize the possibility of the flare case falling back on personnel after the candle and parachute have been ejected. If possible, the mortar should be mounted so the expended case will fall back into the sea. Consideration should also be given to the direction of prevailing winds, in order to avoid having the flare drift over buildings or inflammable material. Although the flare will have been completely burned out at about 400 feet, it is possible that it may descend considerably below this height.

When mounted on shore, a wooden barricade should be erected about 30 feet from the mortar through which the lanyard will be pulled. This will provide protection against what slight possibility there may be of premature functioning. When mounted on a boat, steps should also be taken to provide adequate protection for personnel.

After completion of exhaustive tests conducted by the Coast Guard Air Rescue Unit, Northern California sector, discussion of the flare's efficiency brought out that on a clear night, the flare will illuminate an area of about two square miles; if the overcast is 2,000 feet or higher (clear night), the area of illumination will be the same; if the overcast is below 2,000 feet (clear night), the flare will illuminate about one square mile; if the overcast is below 500 feet, the burning time of the flare, after it falls below the overcast, is too short for it to be of practical use.

The distance at which persons and life rafts may be seen from a rescue boat by the flare's illumination will vary—depending upon visibility, height of the object above the water, its color, and the position of the flare in relation to the position of the observer and the object of search. It was found that the best results were obtained when the object was silhouetted by placing the flare behind it.

It was further found that in order to insure good coverage of an area, it should be swept at least twice, and as many lookouts as possible should be posted—all of them thoroughly briefed on the size, shape, and color of the objective.

Aircraft, of course, can sweep a larger area in less time with one flare, and the boats can also search by the light of the flare dropped by the aircraft. It was recommended that aircraft remain above 1,500 feet when using these high altitude parachute flares.

the safety transmitter and world-wide HF/DF airways

JET plane flights from New York to Washington in less than 30 minutes—radar contact with the moon . . . these are but two of many developments which symbolize the advance in two fields of science—aviation and electronics.

News stories of rapidly recurring accomplishments in these fields are understandably bewildering to the man in the street. He is vaguely aware of tremendous forces at work which will alter his way of life—speed its tempo—make him neighbor to the world. Yet, unless he has a direct interest in one of these fields, it is not particularly important to him which one of them advances more quickly than the other. Aviation, because of its closer, more practical human aspects, may lend itself to more dramatic news presentation . . . while electronics, a more technical subject from the point of view of average knowledge, may lack the "color" necessary for quick public assimilation.

What is important to him, however, is that these scientific developments be permitted to continue in order to provide the greatest benefit to the greatest number; and that we shall not fail to capitalize on the tremendous advancements in scientific research and development which were "pressured" by the urgent requirements of war.

Scientific development in the electronics field has permitted undreamed-of progress toward the mastery of space—it has, for all practical purposes, reduced the world's areas to a series of inter-dependent neighborhoods. Most of the finest achievements in the electronics field know only the application of wartime needs. Their potentials of usefulness to a peacetime world have not yet been fully tested, although little doubt exists that most of them will here find even greater fields for service.

During the war, the radio and radar direction finder nets represented an important cog in the field of military intelligence. They were used to "tag" enemy radio and radar stations, and extract their plans and secrets. They sought out the enemy, watched his movements, tracked him down. They were the eyes and ears of our aerial missions—guiding them, watching over them, directing them safely back to base. Their value in wartime intelligence and safety work is a matter of record. It does not require any unusual imagination to visualize the value of such a world-wide locating and safety service to the world of today and tomorrow. There will be obstacles, of course, but a firm foundation has been laid upon which continued research may be expected to effect a practical conversion.

A comprehensive network of world airways is already in being and is subject to rapid, continuing expansion. Intercontinental flights over long expanses of water and sparsely populated land areas is a daily occurrence. One of the basic structures upon which the successful operation of this world-wide airways system is built, is the organization whose job it is to make these world-wide routes safe and, when accidents or emergencies do occur, to provide an efficient search and rescue service. Such an organization is already in existence, with a "know-how" of operation based upon a wartime experience which has been effectively transposed to a useful peacetime function. This one phase, in itself, offers a fertile field of opportunity to the electronics engineer.

A fundamental requirement of this search and rescue organization is for a system of communication that will make it possible to alert its various components quickly, and locate an aircraft or vessel in distress accurately. Wartime experiences indicated that radio direction finders offered a possible solution. Tremendous strides had been made in the realm of high

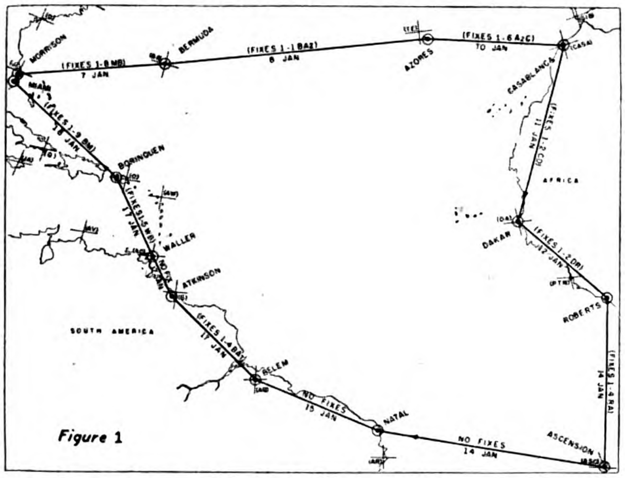


Figure 1

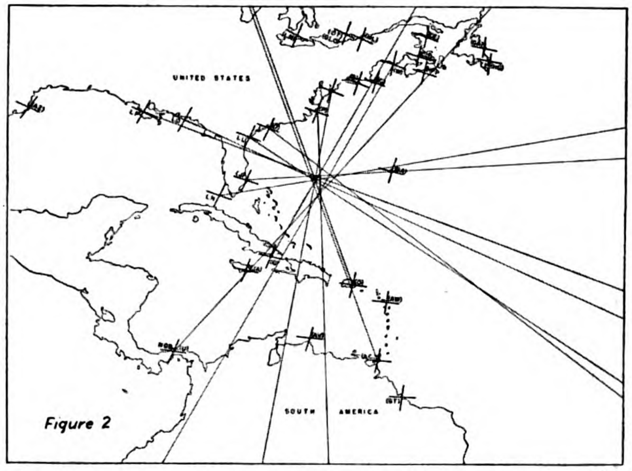


Figure 2

frequency direction finding, and certainly it was reasonable to assume that its benefits could be efficiently applied to servicing both a world-wide airways system, and the "safety," or rescue, organization which supported it.

Electronics engineers of the United States Coast Guard conducted considerable research and experiment on many phases of the problem. Particular emphasis was placed upon the development of an airborne automatic transmitter which would transmit distress signals on the 8280 kc. band, and close the gap caused by the peacetime reduction in the number of IFF radar listening posts. The transmitter, known as the RL–226–A, was described in the February 1946 edition of the Air Sea Rescue Bulletin.

The project was first initiated early in 1945. Experimental models were built, tested, refined, and rebuilt . . . until finally the unit was believed ready for exhaustive field trials. In December 1945, following a joint conference of representatives of the Caribbean Wing, AAF, Air Transport Command and various Coast Guard officers, arrangements were completed to conduct these trials. The RL–226–A, with the identifying designator "CD," set up on a frequency of 8280 kc., was installed in an Army C–54 aircraft, No. 5516. The plane took off from Morrison Field, West Palm Beach, Fla., on 7 January and returned on 18 January 1946. Tests were conducted under the supervision of Capt. F. Catanzarite, flight radio officer, Caribbean Wing, ATC.

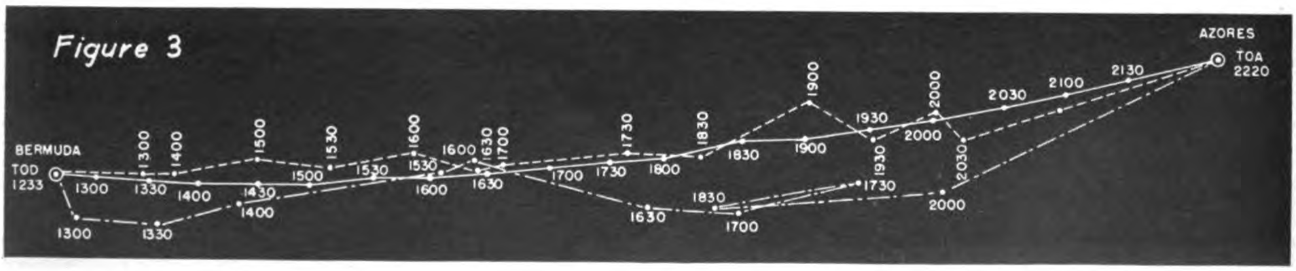
So far as is known, this operation, which proceeded from Morrison Field, Fla., to Bermuda, the Azores, Casablanca, Dakar, Roberts Field, Ascension Island, Natal, Belem, Atkinson Field, Waller Field, Borinquen Field, Miami, and back to Morrison Field, was probably the first thoroughly coordinated HF/DF test effort to actually "track" an aircraft on a transoceanic flight . . . and it is safe to assume that additional such tests will improve the accuracy of bearings and the consequent evaluation of fixes.

Figure 1 charts the entire route of the flight, and shows the dates and the indicator for the charts of the individual plots for each fix.

Figure 2 showing the large number of stations which were able to take bearings on the leg of the flight from Morrison Field to Bermuda, illustrates what is known as a good fix. Eight fixes were taken on this leg of the flight, all of them combining to provide a high degree of accuracy.

Figure 3 shows the track of the flight from Bermuda to the Azores. During the early part of this leg—up to 1730R, and until bearings were received from stations in Great Britain relayed from the Eastern Sea Frontier Evaluation Center, fixes continually "lagged" the DR positions. Incidentally, this was the

Figure 3



first opportunity afforded the Gulf Sea Frontier Evaluation Center at Miami to observe bearings from this area, and the experience was valuable. The number of stations which were able to take bearings on the Bermuda-to-Azores track are shown in Figure 4. After bearings on the Azores run were obtained from stations in the British Isles, it was possible to plot more accurate fixes. The AACS fixes alone, point out the desirability of a larger number of bearings to provide for more successful fixes between Bermuda, the Azores, and Casablanca. This will require the close coordination of all agencies . . . the combined effort of the Coast Guard, AACS, and United Kingdom nets.

On the leg from Borinquen to Miami (Fig. 5), there were nine transmissions and nine fixes plotted which provided excellent overall results. All of the D/F Net Stations participated in bearings of each of these transmissions. The letters DR on this chart indicate the position of the plane as determined by its navigator; ZE indicates the plane's position as fixed, or plotted, by the D/F Evaluation Center.

Figure 6 shows the fix and illustrates the station plots on the flight leg from Roberts Field to Ascension Island.

Summarizing . . . 8 fixes were obtained on the leg from Morrison Field to Bermuda; 15 from Bermuda to the Azores; 6 from the Azores to Casablanca; 2 from Casablanca to Dakar; 2 from Dakar to Roberts; 4 from Roberts to Ascension; none from Ascension to Belem; 4 from Belem to Atkinson; 5 from Atkinson to Borinquen; 9 from Borinquen to Miami.

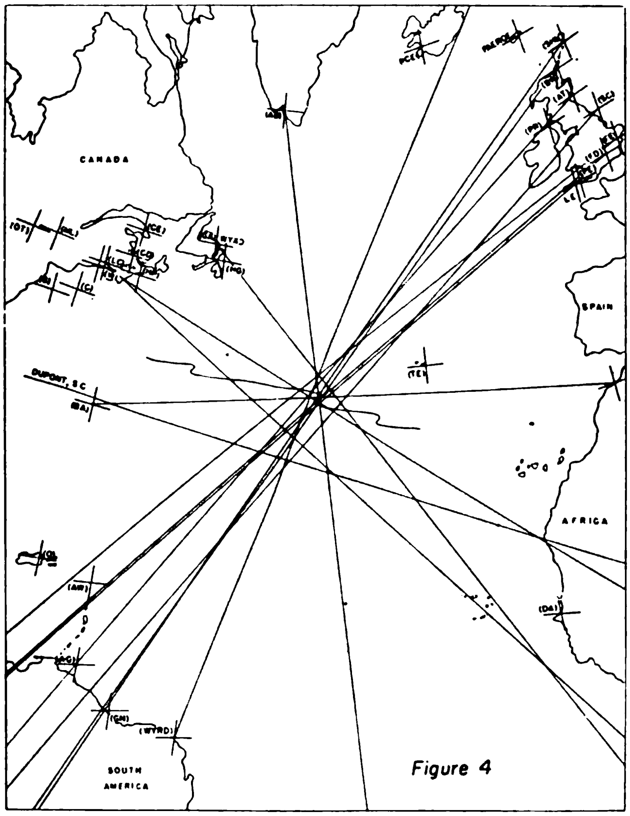


Figure 4

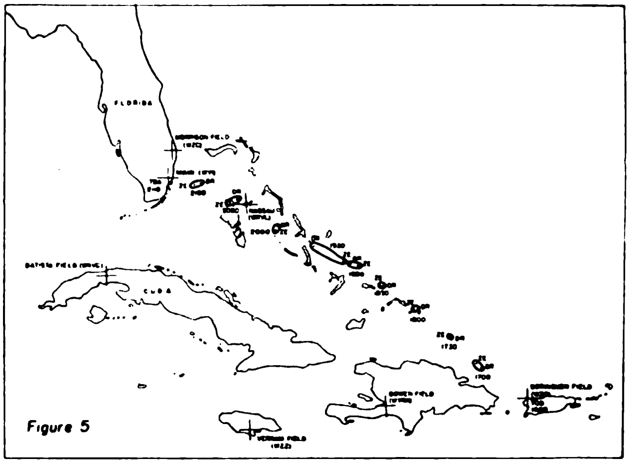


Figure 5

The report of this test and an evaluation of its results, definitely does not represent the ultimate of achievement. It is merely a beginning . . . and therein lies the greatest hope for the future—that from this beginning will eventually come an important contribution to safety at sea and in the air, through a system of communication so sound and so complete in its conception as to remove the last final element of guesswork or mechanical failure.

Here is a transmitter with a low power output of but 10 watts, which demonstrated its ability to operate at distances up to 5,000 miles. Unquestionably its record of performance indicates that further tests should be made in order to realize the fullest potentials of a transmitter of this type, coordinated with the HF/DF network.

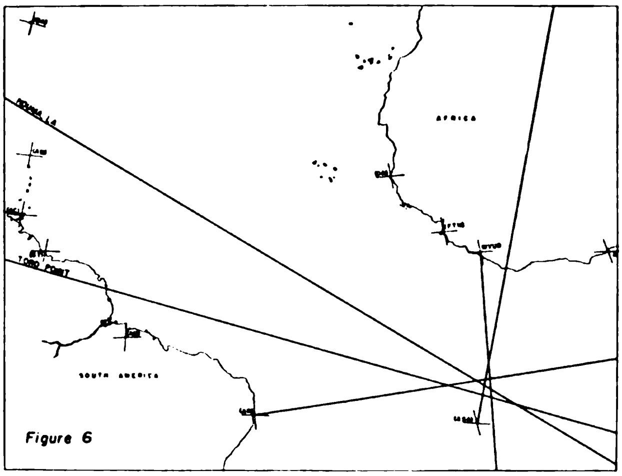
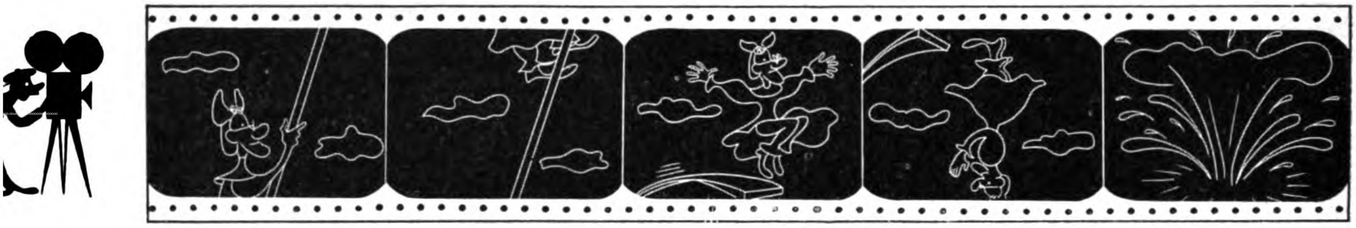


Figure 6



Cinematic Catholicon

Prior to his assignment to the Air Sea Rescue Agency as Motion Picture Officer, Lt. Comdr. Don Farran was, for 3½ years, a writer-producer of motion pictures for the Navy, averaging one picture a month in color. He was formerly national director for many of the largest research projects conducted by the United States Library of Congress; is the author of many short stories and articles for national magazines; is the author of a life of Johann Gutenberg, inventor of printing; editor of many bibliographical volumes; playwright and script writer for radio and motion pictures.—Ed.

AT THE Provisional International Civil Aviation Organization's Dublin conference during March 1946, the following recommendation was unanimously passed:

Whereas each member State is dealing with the training of search and rescue personnel is desirous of obtaining instructive material; and

Whereas only a very limited amount of search and rescue instructive material is now available; and

Whereas motion-picture films represent an excellent medium for training instruction; and

Whereas the Air-Sea Rescue Agency, Washington, has available in its library, information for such search and rescue training information;

Now therefore it is recommended that the Air-Sea Rescue Agency be requested to prepare two or more films for circulation among all member states within the North Atlantic Route Service Organization for the purpose of instructions to search and rescue air and ground crews with the expectation of general improvement of search and rescue operations throughout the area.

Assuming that the purpose of such films will be to establish standardized practices and techniques from which member States may model their own search and rescue organizations, a broad program of motion pictures and training films seems indicated. Questions concerning the financing of such a program belong to desks other than this one, whether they be the armed services, PICAO itself, or member states. What we suggest here is the utilization of films already produced or to be planned, for the expressed objectives of exchanging the best available practices between member states in a form which can be understood and which will not be subject to misinterpretation. The use of appropriate language soundtracks is contemplated.

The suggestions and comments contained in this article are not official, but are offered as an attempt to approach some of the problems involved in setting up a search and rescue system between member States.

OPEN SEA SEAPLANE OPERATIONS NO. 1

This is a 30-minute motion picture in 16 millimeters black-and-white, sound, cut from footage shot during rough water landings and take-offs with a PBM–3 plane off the coast at San Diego during 1943 and 1944. The tests were made to determine the best techniques in rough water operations; i. e., landings and take-offs, with seaplanes equipped to measure various stresses on the plane, etc. Essentially a photographic report film, it should prove invaluable to military and civil personnel operating planes of similar types. Additionally, it may be of value to pilots who are faced with the necessity for ditching and who are unfamiliar with the danger of swells in the open sea. Produced by the United States Coast Guard Air Station, San Diego, the picture is distributed by the United States Navy.

STANDARDIZATION OF OCEAN STATION VESSEL CREW PROCEDURE IN SEARCH AND RESCUE

This is the first of a new series of training pictures designed to standardize crew training in SAR aboard Ocean Station Vessels. It will consist of a number of pictures, each concerned with training in a particular subject, such as:

(*a*) OSV crew drills during search and rescue;

search Doctrines when OSV must leave station and search vicinity for survivors.

(*b*) Pick-up boat crew training, including rescue of injured (flotation litter, rescue basket, etc.) and treatment for shock, exposure, etc.

(*c*) Operation of communication devices (electronics).

(*d*) Operation of aids to visibility (manual signaling, searchlights, pyrotechnics, float lights, smoke markers, etc.).

(*e*) Training in operation plans between OSV and "ditching" planes.

(*f*) Possible use of oil slicks with OSV wake to provide landing surface for planes to land or ditch upon.

The audience for these training pictures would consist of all personnel concerned with search and rescue on water; civilian air-line crews; foreign countries engaged in search and rescue, with appropriate sound tracks; and interested government agencies of the various countries.

Because of the importance of color in search and rescue equipment, it is hoped that these pictures may be shot in 16-millimeter color with sound, both for added visibility factors and approximation of real conditions.

STANDARDIZATION OF CREW TRAINING IN SEARCH AND RESCUE FOR AIR SEA RESCUE CRAFT (63, 83, OR 85 FEET (ARMY)), 110 FEET

This series of training films, like the ones mentioned above, will be designed to provide standardized crew training for smaller crash and patrol craft. Each will relate to specific duties, such as:

(*a*) Advanced training in basic seamanship, and training in teamwork with other boats of this type.

(*b*) Operation of electronic devices (when carried); of manual signaling devices, aids to visibility, etc.

(*c*) Proper use of exposure suits, life vests, inflatable boats, and rafts, rescue hoists, rescue baskets.

(*d*) Care and handling of survivers.

(*e*) Proper approach to planes forced down, and to rafts, survivors in water, etc.

(*f*) Training in operational plans between planes forced down or ditched and these types of rescue craft.

Because in general a particular type of small craft will be used by all military services in all countries, varying but little in power and design to fit local conditions of weather or sea or distance involved, these training films should well serve to train all personnel concerned within a world-wide system of search and rescue. As in the pictures on OSV crews mentioned above, these should be produced in 16 millimeter color with appropriate sound tracks in the language of use.

Only through standardized practices, as demonstrated in the films, may a foreign plane flying over American waters or an American plane flying over foreign waters obtain maximum safety in a search and rescue situation.

OCEAN STATION VESSELS—DITCHING

In this picture a ditching situation is contemplated, involving a commercial air lines plane and passengers. While it is hoped that no such situation will ever exist, its possibility, if not probability, is such that all hands should be trained to operate without loss of time or energy. Survival for many lives of crew and passengers may depend upon preplanning and ability to operate under any conditions, day or night, good or adverse weather, and good or bad ditching technique.

The factors involved should consist of a commercial air line plane, an Ocean Station Vessel, a patrol plane with droppable lifeboats, and Rescue Coordination Centers and Rescue Units.

The problem is that of a commercial air line passenger plane en route from abroad to the United States. Near the "chop line" in the middle or Caribbean area of the Atlantic the plane has failure on one or two of its engines and notifies the nearest Coordination Center and Ocean Station Vessel that it may have to ditch. It proceeds toward the nearest OSV which is just across the "chop line" on the American side. Meanwhile, a French patrol aircraft on long-range training flight in the area is ordered to intercept and fly alongside the commercial air liner to provide the protection of its droppable lifeboats, etc. The Coordination Center, manned by the British, will issue instructions to the two planes until the commercial air liner ditches or until radio contact is lost.

As the air liner approaches the Ocean Station Vessel, it receives weather and surface condition reports, and chooses the particular plan to be used (i. e. ditching to starboard, port, ahead, behind OSV, etc.) In this way each knows exactly what the plan of the other will be to effect an immediate rescue.

Commercial air liner ditches (done with model photography) in the assigned position, and the ASR rescue boats effect the rescue of the survivors from the plane's rafts. Proper treatment by medical personnel aboard the OSV is given, if required, and the

SAR network is notified that rescue has been effective.

This is, of course, a broad outline of the proposed picture. All elements that comprise such a rescue will be included in the picture, such as communications, interior of Coordination Center handling the incident, use of rescue equipment, creation of wake, placement of smoke markers, etc.

It is felt that this picture will establish procedure and clarify lack of information regarding such procedure in ditchings near Ocean Station Vessels.. In addition to military use, it might well serve to indoctrinate commercial air line pilots and crews. Some air liners may wish to use it as passenger information.

STANDARDIZATION OF CREW TRAINING IN SEARCH AND RESCUE PLANES

A motion picture on this subject is as essential as one for training the crews of OSV's and smaller rescue craft. In addition to teaching cooperation with Ocean Station Vessels and other rescue vessels at sea and the use of various communication, navigation, and safety devices, it should instruct in the elements of Land Rescue, such as aerial supply to survivors, identification and marking of crash sites (photography, mapping, etc.), the use of the L–5 land plane, and the Norseman plane mounted on skiis, parachuting of medical personnel to survivors, etc.

No doubt, this would break down into two series, SAR over water, and SAR over land, for appropriate audiences.

OPERATION OF LAND RESCUE UNITS

Some elements of this picture or series would be embraced in the SAR plane series mentioned above, but essentially this is meant to cover the search and rescue techniques covering land incidents, considered from ground search instead of air search. It should indicate organizational facilities such as communication, telephone, radio walkie-talkie, and their use), map-reading indoctrination, photographic interpretation, transportation facilities covering all weather conditions, available personnel, including local civil organizations (State or national guard units, local police, etc.).

This series would tie-in with the following picture or series:

COORDINATION OF LAND RESCUE UNITS WITH LOCAL AUTHORITIES

To be completely effective, search and rescue must utilize every facility possible. Local or State units, such as militia, civil peace organizations, police departments, etc., should be coordinated with search and rescue and be prepared to act without delay on prepared plans of operation. In any SAR incident, human lives are at stake, and time and medical treatment are immensely important factors to survival. Like the local fire department, all hands must be prepared to act at once and act in unison under a central authority.

A motion picture which would present a rather ideal plan for such coordination could be the basis for creating it or serving as a model for it world-wide. Such a plan would be operative in situations other than flights by air, and would offer protection which at the present time is haphazard at best.

COORDINATION CENTER OPERATION

The center of all search and research is the Rescue Coordination Center. Operating 24 hours a day, every day, it is the "brain" into which flow the position reports of planes and ships in their ever-changing pattern. Connected by radio and telephone with rescue stations, offices of the militia and police, it can immediately alter all necessary facilities when SAR must go into action. It can divert ships at sea, send search planes, alert Ocean Station Vessels, or request civilian and military organizations to go into action.

A motion picture presenting its operation and functions during an alert and subsequent search and rescue would orient all concerned and serve as a model for similar Coordination Centers to be set up in all countries. Even since the war ended new devices have been perfected for insuring the safety of those who travel and are in use in some of the centers. Distribution of information regarding their operation, through the medium of the motion picture, would tend to bring them into use in all countries.

SOFAR

In this new medium of long-range, deep-channel sound transmission (see article in AIR SEA RESCUE BULLETIN, April 1946) a well-known principle of sound wave constancy is utilized. Signals (bombs) set up at depths of from 3 to 4,000 feet below the surface of the ocean will register across vast distances, theoretically up to 10,000 miles. A plane ditching in midocean and dropping a signal bomb can be pinpointed by the recording stations.

A motion picture in animation describing the principles involved and the methods of determining a fix

would be of great value to all hands engaged in search and rescue, and particularly to search and rescue plane crews. Here is a prime example of how animated motion pictures can explain the application of new principles to search and rescue.

VISIBILITY RANGE OF SIGNAL EQUIPMENT IN SEARCH AND RESCUE AT SEA AND ON LAND

A motion picture on visibility of signal equipment, flares, mirrors, smoke signals, life rafts, parachutes of various colors, at sea is being cut from footage made during tests conducted off San Juan by the Bureau of Aeronautics. It is believed that a second picture should be made with latest equipment, to relate search doctrines to the position of the sun and with atmosphere conditions.

A similar picture should be made to prove visibility on land. Smoke signals and fabric coloration among heavily wooded areas, the variation of visibility on flat terrain and in mountainous regions, these and other similar aspects should be recorded by the motion picture camera so they may be studied by research men and plane crews engaged in search and rescue. Transmission of such specific information is best realized through motion pictures in color, with the possibility of third-dimensional camera use.

SURVIVAL, IN TROPICS, IN ARCTIC, ETC.

The Army has made a series of motion pictures, Land and Live series, which deal with survival in the Arctic, the desert, the Tropics, etc. A cutting job done on these pictures to provide a 30 minute composite film, if that is practical, would make very important information accessible to the plane crews in search and rescue of many countries. The series contains good photography and good acting, often by professional casts who were in Army service.

No doubt there is much recoverable material already shot which could be utilized in this way to provide much-needed information for all countries. Some of it may exist in footage shot by the British and other of our allies; some may even be available from former enemy sources. (See article, Don't Ignore It, Explore it, AIR-SEA RESCUE, March 1946.)

It is felt that a definite program should be set up and placed in operation at the earliest opportunity to provide for all PICAO members such vital information. The fastest, surest, most understandable method of assuring that standardized information is provided lies in the use of the motion-picture medium.

I. History

1. BETWEEN TWO WARS

DURING the war, the rapid organization of a world network of airways by the Air Transport Commands of the Allied Nations focused attention on the problems and great possibilities of civil air transport. It became clear that rules for civil aviation—mutually workable among the nations of the world—must be evolved and enforced by common censent. The alternatives—postwar disorder in the air and the inherent seeds of international economic and political strife—were foreseen.

Out of these hopes and fears grew the International Civil Aviation Conference. The broad purpose of the conference, which began at Chicago on November 1, 1944, was to consider the speedy establishment of an international civil air service pattern, so that the benefits of the immensely expanded wartime air transportation might be brought to all peoples.

Such an international concept was not without precedent. In 1919, the Paris Convention had established the International Commission for Air Navigation, which set up standards on technical matters and provided for the connection and exchange of information among member states. Although 33 nations adhered to the Paris Convention, a number of states, including the United States, the U. S. S. R., China, and Brazil, were not parties to it.

The Pan American Convention on Air Navigation, drawn up at Havana in 1928 and ratified by the United States and nine other American Republics, pledged members to observe certain principles in their

dealings with one another. Among these principles were included that of the freedom of air passage. Unlike the Paris Convention, however, no attempt was made at Havana to develop uniform technical standards. Neither was there any provision made for periodic discussion of common problems through the agency of a permanent organization.

2. THE CHICAGO CONFERENCE

Although the Paris and Havana Conventions had served a useful purpose, they were no longer considered as adequate to meet the changed situation in the air, resulting from the immense development of flight during the war. In the early months of 1944, the United States initiated a series of exploratory discussions with other governments interested in the development of international civil aviation. These discussions revealed sufficient agreement among the principal air powers to justify the expectation that "final dispositions" could be reached at an international conference. Accordingly, the United States issued invitations to 55 allied and neutral States to meet in Chicago on November 1, 1944.

The deliberations of the delegates of the 52 nations represented at Chicago resulted in the adoption of a number of resolutions and recommendations constituting the final act of the conference. The final act also contained the texts of the Convention on International Civil Aviation, the International Air Services Transit (Two Freedoms) Agreement, the International Air Transport (Five Freedoms) Agreement, and the Interim Agreement on International Civil Aviation.

3. THE CONVENTION AND THE AGREEMENTS

The Permanent Convention, which will come into force upon ratification by 26 States, laid down, by mutual agreement among the delegates of the participating nations of the Chicago Conference, certain principles and set up machinery "in order that international civil aviation may be developed in a safe and orderly manner and that international air transport services may be established on the basis of equality of opportunity and operated soundly and economically."

Twelve draft sets of regulations, dealing with technical subjects, were adopted. They were incorporated later into the final act. The technical annexes were sent to the participating States for study and to serve as models for future international regulations. Meetings of technical subcommittees were to be set up, to consider the recommended practices for air navigation "as ones toward which the national practices of the several States should be directed as far and as rapidly as may prove practicable."

Both the International Air Services Transit Agreement and the International Air Transport Agreement are supplementary agreements.

The former grants to signatory States two reciprocal privileges:

(*a*) That of flying across the territory of a given State without land.

(*b*) That of landing for nontraffic purposes.

The Transport Agreement included the two privileges of the Transit Agreement, adding to them:

(*c*) The privilege of disembarking passengers and unloading mail and cargo taken on in the territory of the State whose nationality the aircraft possesses.

(*d*) The privilege of embarking passengers and loading mail and cargo destined for the territory of the State whose nationality the aircraft possesses.

(*e*) The privilege of embarking passengers and loading mail and cargo destined for the territory of any other contracting State and the privilege of disembarking passengers, mail and cargo coming from any such territory.

Recognizing the need for immediate action and the fact that a considerable time might elapse before the formalities of ratification of the convention were completed by the required number of States, the conference provided, through the Interim Agreement on International Civil Aviation, for the establishment of a provisional organization of a technical and advisory nature to function until the convention came into force.

II. *The Provisional International Civil Aviation Organization*

1. THE INTERIM AGREEMENT

The Interim Agreement provides that a provisional international organization, known as the Provisional International Civil Aviation Organization, be established. With headquarters in Canada, it will operate until a new permanent convention on international civil aviation comes into force or until other arrangements have been agreed upon at another conference on international civil aviation. In any event, the duration of PICAO is not to exceed 3 years from the coming

into force of the Interim Agreement. The governing bodies of the organization are the Interim Assembly and the Interim Council.

2. THE INTERIM ASSEMBLY

The assembly of PICAO is composed of delegates from member states, each state represented being entitled to one vote. Decisions are made, unless otherwise provided, by a simple majority of the member states present. The assembly is convened by the council and meets annually, through extraordinary meetings may be called at any time by the council or at the request of any 10 member states of the organization.

Member states as of April 1946 were:

Afghanistan.	Lebanon.
Australia.	Liberia.
Belgium.	Luxembourg.
Brazil.	Mexico.
Canada.	Netherlands.
Chile.	New Zealand.
China.	Nicaragua.
Colombia.	Norway.
Czechoslovakia.	Paraguay.
Denmark.	Peru.
Dominican Republic.	Philippines.
Egypt.	Poland.
El Salvador.	Portugal.
Ethiopia.	Spain.
France.	Sweden.
Greece.	Switzerland.
Haiti.	Syria.
Honduras.	Turkey.
Iceland.	Union of South Africa.
India.	United Kingdom.
Iraq.	United States.
Ireland.	

Among the powers and duties of the assembly are the election of its president and other officers, and the election of member states to be represented on the council. The assembly determines its own rules of procedure and is responsible for the financial arrangements of the organization, including the approval of an annual budget. It also examines and takes action in matters referred to it by the council and may, at its discretion, refer to the council specific matters for the consideration of the latter body. Finally, the assembly deals with such matters as come within the sphere of action of the organization but are specifically assigned to the council.

3. THE INTERIM COUNCIL

A. *Composition.*—The Interim Council is the executive instrument of the organization and derives its powers and authority from the Interim Assembly. It constitutes, in fact, an international parliament on civil aviation matters. It is composed of not more than 21 member states, elected by the assembly for a period of 2 years.

In electing members of the council, the assembly must give adequate representation to:

(*a*) Those member states of major importance in air transport;

(*b*) Those member states not otherwise included which make the largest contribution to the provision of facilities for international civil air navigation; and

(*c*) Those member states not otherwise included whose election will ensure that geographical areas of the world are represented.

The following states are now represented on the council:

Australia.	France.
Belgium.	India.
Brazil.	Iraq.
Canada.	Mexico.
Chile.	Netherlands.
China.	Norway.
Colombia.	Peru.
Czechoslovakia.	Turkey.
Egypt.	United Kingdom.
El Salvador.	United States.

Decisions taken by the council are valid only when approved by the majority of the council. Any member state not represented on the council may participate in the deliberations of the council, but without the right to vote, if a decision is to be taken which specifically concerns any such state. Similarly, invitations may be extended to nonmember states, representatives of public international organizations, public or private bodies or authorities, to participate in council meetings or to send observers. Such invitations do not, of course, carry the right to vote.

B. *Functions.*—The council has certain specific functions which are set out in the Interim Agreement.

It must provide for the establishment of such subsidiary working groups as may be considered desirable, among which there will be a Committee on Air Transport, a Committee on Air Navigation, and a Committee on International Convention for Civil Aviation.

The council supervises and coordinates the work of the three technical committees, receives and considers their reports, transmits to each member state these reports together with the findings of the council, and makes recommendations, with respect to technical

matters, to the member states of the assembly individually or collectively.

The council has also to maintain liaison with the member states of the organization. It must receive, register, and hold open, for inspection by member states, all existing contracts and agreements relating to routes, services landing rights, airport facilities, or other international air matters to which any member state or any airline of a member state, is a party. It submits an annual report to the assembly and, when expressly so required by all parties concerned, it may act as an arbitral body on any differences arising among member states in regard to international civil aviation matters. The council, in such an event, may either render an advisory report or make a decision which all parties concerned must accept as final if they have previously agreed to adopt this latter course.

Among its administrative duties, it must determine the method of appointment, salaries, and conditions of service of employees and serve as the final authority on the expenditures of the organization.

C. *Officers.*—The Interim Council has elected a president, Dr. Edward Warner, and a secretary general, Dr. Albert Roper. The functions of the president of the council are to convene and preside at meetings of the council and to act as the council's permanent representative. The council has also elected from among its members three vice presidents, Dr. F. H. Copes van Hasselt (Netherlands), Col. C. Y. Liu (China), and Dr. Guillermo E. Suarez (Colombia).

The secretary general is the chief executive and administrative officer of the organization. He is responsible to the council for carrying out duties assigned to him by that body. It is his responsibility to select and appoint the staff of the secretariat, whose activities he supervises and directs.

D. *Finances.*—The expenses of the organization are borne by the member states in proportions decided by the assembly. Each member state has been requested to advance funds, in accordance with the scale suggested by the council, in order to cover the initial expenses of the organization.

III. *Adherence to the Interim Agreement*

At the conclusion of the Chicago Conference, on December 7, 1944, prompt measures were taken to bring into being the Provisional International Civil Aviation Organization. By June 6, 1945, the required number of 26 nations had adhered to the Interim Agreement, and the way was clear for a committee of the Canadian Government to make arrangements for the first meeting of the Council of the Provisional International Civil Aviation Organization.

IV. *The Canadian Preparatory Committee*

A Canadian Preparatory Committee was formed in June 1945, with instructions to make all necessary arrangements for the first session of PICAO. Offices were established in Montreal and a staff was obtained on loan from various Canadian Government departments. The secretary general of ICAN was also invited to participate.

Due mainly to its accessibility by air transport, the city of Montreal was selected by the committee as the most suitable Canadian city for the site of PICAO. August 15, 1945, was selected as the date for the opening of the first session of the Interim Council. Arrangements were made for temporary housing of the secretariat in the Dominion Square Building, Montreal, and office equipment and furniture were supplied on loan by the Canadian Government. The council was able to hold its first session in a little over 2 months after the necessary signatures had been obtained to bring the Interim Agreement into effect.

V. *Council Sessions*

The Interim Council, which is deemed to be in continuous session, has been convened on four occasions.

The first session, which opened August 15, acting on recommendations made by the Canadian Preparatory Committee, continued the initial organization work and was mainly procedural in character. Dr. Edward Warner was elected president of the Interim Council, ceasing to represent his country, the United States, upon his election. Dr. Albert Roper, formerly secretary general of the International Commission for Air Navigation, was appointed Secretary General of the Organization.

By the second session of the council which opened October 15, the permanent Committees on Air Navi-

gation, Air Transport, Personnel, and Finance were functioning and reports were submitted for the approval of the council. To examine the specific problems of air navigation facilities and services, the session decided to convene a series of route service meetings throughout the world.

Among the important decisions made by the council at the third session beginning January 21, was the adoption of the texts of the Standards and Recommended Practices developed by the first group of technical divisions of the Air Navigation Committee.

The fourth session was convened on April 2.

VI. *Committees and Divisions*

Among the powers and duties assigned to the council by the Interim Agreement was the establishment of the Interim Committees on Air Transport, Air Navigation and International Convention on Civil Aviation.

Of these three permanent committees, the Committees on Air Navigation and Air Transport are well advanced with their programs. The Committee on International Convention on Civil Aviation is not as yet in operation. The Committee on Air Transport has the function of studying "any matters affecting the organization and operation of international air services." The Committee on Air Navigation "studies, interprets, and advises on standards and procedures with respect to communications systems and air navigation aids and recommends the adoption of minimum requirements and standards." These standards and recommended practices aim at achieving uniformity in international air operations.

Due to the amount of detailed work that is involved in the drafting of these standards and recommended practices, the Air Navigation and the Air Transport Committees have been so organized that the initial work of drafting is assigned to various divisions, including working groups on aerodomes, air routes and ground aids, rules of the air and air traffic control, meteorology, communications, search and rescue, maps and charts, personnel licensing, investigation of accidents, air line operating practices, and airworthiness.

Six of these technical groups—rules of the air and air traffic control communications, meteorology, search and rescue, maps and charts, and ground aids—have submitted their final reports to the committee. The reports set forth standards and recommended practices, as well as recommendations of measures which the groups feel would be beneficial in their respective fields.

The Air Transport Committee has, at present, one division on facilitation of air transport. This division has prepared a report upon customs procedures and manifests, public health regulations, travel documents, facilities, and procedures for monetary exchange, and other related matters, with a view to removing and minimizing obstacles to air travel at international borders. The report was sent to 42 member states for their consideration.

In addition to the Interim Committees and their divisions, administrative committees to deal with finance, personnel, publications, credentials, and public information have been set up.

As indicated by its name, the Finance Committee prepares the budget of the organization and, among its other functions, it reports to the council on the assessment and collection of contributions of member states.

The Personnel Committee advises on personnel policies and makes recommendations to the secretary general on appointments.

The Publications Committee advises on the printing of the organization's publications, notably the organ of the organization, which is to appear monthly under the name of the Picao Journal and of which there will be an English, French, and Spanish edition.

The Credentials Committee determines the type of information required in credentials presented by delegates of states.

The Public Information Committee advises on publicity matters and is responsible for the information policy of the organization.

VII. *Languages and Publications*

Work of the organization is conducted and its publications and documents are issued in the three official languages of PICAO: English, French, and Spanish. The organization has a publications and documents section which is responsible for all translations and for publication of the Picao Journal, a monthly publication on the organization's activities.

The organization is also preparing a multilanguage aeronautical dictionary of standard definitions.

Publications issued to date are: Recommendations

of PICAO for International Standards, Practices, and Procedures on charts, communications, air traffic, aerodromes and ground aids, meteorology, search and rescue accidents investigation, and personnel licensing.

Other standards, which will cover airworthiness and air line operating practices, are in preparation. Special reports will be published on regional meetings as well as other future activities.

VIII. *Regional Meetings*

From the work of PICAO technical groups it is expected there will emerge standards that will make for uniform flying procedures on international air routes and help in opening up the world to commercial air traffic.

To implement these standards and recommended practices as rapidly as possible, PICAO has launched a program of regional meetings. These meetings will consider the standards and their application to the requirements of particular regions. The meetings will have another major task: to consider the value, for civil use, of the facilities developed during the war by the Allied Governments.

It is not generally realized how great was the expenditure of energy and money on the establishment and maintenance of facilities and services for military transport routes. Many hundreds of airports were built; weather observation stations and search and rescue centres were established. Without these facilities and services, civil aviation would be seriously handicapped; yet the conditions of their operation face inevitable change, and require international consideration.

The first of the regional meetings, called by PICAO to meet these problems on a regional basis, was held in Dublin on 4 March to consider the North Atlantic region. Thirteen nations took part: Belgium, Canada, Denmark, France, Holland, Iceland, Ireland, Norway, Portugal, Spain, Sweden, the United Kingdom, and the United States.

The second meeting was held in Paris starting 23 April to consider the European-Mediterranean region. Twenty-two nations took part.

A Middle East region meeting is scheduled at Cairo in late summer, and other meetings for the South Pacific, Caribbean, South Atlantic, South America, Africa, Indian Ocean, and North Pacific, will take place later.

IX. *Liaison With Other International Organizations*

PICAO also maintains liaison with other international organizations such as: the International Commission for Air Navigation, the International Technical Committee of Experts in Air Law, the International Air Transport Association, the International Chamber of Commerce, the International Meteorological Organization, the International Telecommunications Union, the International Hydrographic Bureau, the Institute of Geography and History of the Pan American Union, the Federation Aeronautique Internationale, and the International Labour Office.

SAFETY AID FOR TRANSATLANTIC FLIGHTS INAUGURATED

In the interest of promoting maximum safety in transoceanic flight, a daily surface ships' position service has been inaugurated by Air Sea Rescue Headquarters, Eastern Sea Frontier.

Each day at 1200 EST (1700 GMT) this headquarters will furnish CAA communications (WSY) La Guardia Field, N. Y., with a list of estimated positions of ships known to be sailing to and from Europe and North America and being near to the overseas airline routes. This information will be retransmitted by CAA to the operation offices of overseas airlines in the form of a notice of airmen (NOTAM), for dissemination to the crews of their transatlantic flights.

The first column of this notice to airmen contains the international radio call. The second column contains the name of the vessel; the third, its destination. In the fourth column are indicated the hours of radio watch which the vessel stands; the figure 24 indicating continuous watch, 16 indicating a 16-hour daily watch, 8 indicating 8 hours of continuous watch, and X8 indicating that 8 hours of total watch are stood at various periods during each day.

The fifth column indicates the anticipated speed of the vessel in knots. The sixth and seventh columns indicate the estimated position of the vessel at 1700 GMT on the date of the report, latitude (north) first, longitude (west) second. The last column indicates the vessel's intended true course.

short shorts

Special Binoculars Used for Navy's Night Lookout Operations

Night-fighter pilots, ship lookouts, and submarine lookouts searching dark horizons in wartime operations used special binoculars developed at the instigation of the Navy's Bureau of Aeronautics.

Since ordinary search glasses are of little use at night because the fovea, the eyes' central focus point for day vision, becomes a blind spot, the Bureau's Instruments Branch had two manufacturers develop binoculars with an exceptionally wide field of vision.

After training in the proper use of the new binoculars, pilots found they could greatly extend their range of vision in locating and identifying objects at night. Finally, exposed surfaces of the glasses were given a nonreflecting coating in order to transmit the maximum amount of light.

Two types of wide-angle binoculars, one magnifying six times, the other seven, proved the most practical for maximum range at night without sacrificing a wide field of vision. These are being increasingly used by ship and aircraft personnel.

70 Weekly Transatlantic Trips

A forecast of 70 trans-Atlantic trips a week was given at a meeting of PICAO's North Atlantic Route Service conference. Frequencies expected to be in effect by the end of 1946 were: TWA 18, PAA 10, AOA 9, BOAC 14, TCA 7, SILA (Sweden) 3, DDL (Denmark) 3, DNL Norway) 1, KLM (Netherlands) 2 or 3, Air France 2. *American Aviation.*

change of address

By the time you read this, the Air Sea Rescue Agency will have moved to its more centrally located office in Was
1300 E Street, NW. The telep
ber is EXecutive 6400, Extensi
5007–5011–5021–5250 and 5

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AIR SEA RESCUE LIAISON OFFICERS

R. L. Burke, *Captain,* USCG
Eastern Sea Frontier
90 Church St., New York 7, N. Y.

T. J. Harris, *Commander,* USCG
Western Sea Frontier
Federal Bldg., San Francisco, Calif.

Vacancy

Vacancy
ComAirPac, Coast Guard Box No. 1
Navy 48, San Francisco, Calif.

O. D. Weed, *Commander,* USCG
c/o Commander, 17 CGDistrict
Ketchikan, Alaska

BULLETIN EDITOR
Lieutenant Commander
R. E. Fowler, USCGR

PICAO REGIONAL MAP

—showing the twelve regional areas into which the world has been divided for the purpose of determining operational responsibility.

Air Sea Rescue Agency. July 1946

Air Sea Rescue bulletin

FEBRUARY 1946
NAVCG 128, Vol. III, No. 2

RESTRICTED

Air Sea Rescue bulletin

Information contained herein is assembled from various United States and foreign sources; it is disseminated in this BULLETIN for information only to a limited list of addressees with interest in the field of air-sea rescue. It will be apparent that the BULLETIN may contain information which does not respresent the policy of the Air Sea Rescue Agency or the Services represented on the Board for Air Sea Rescue.

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Since the June 1944 issue of the BULLETIN, you—our readers—have offered many helpful comments and constructive criticisms on how best to make it conform to your editorial and readability requirements. This new BULLETIN, we hope, is a practical step in the direction you've indicated.

Do you like it?

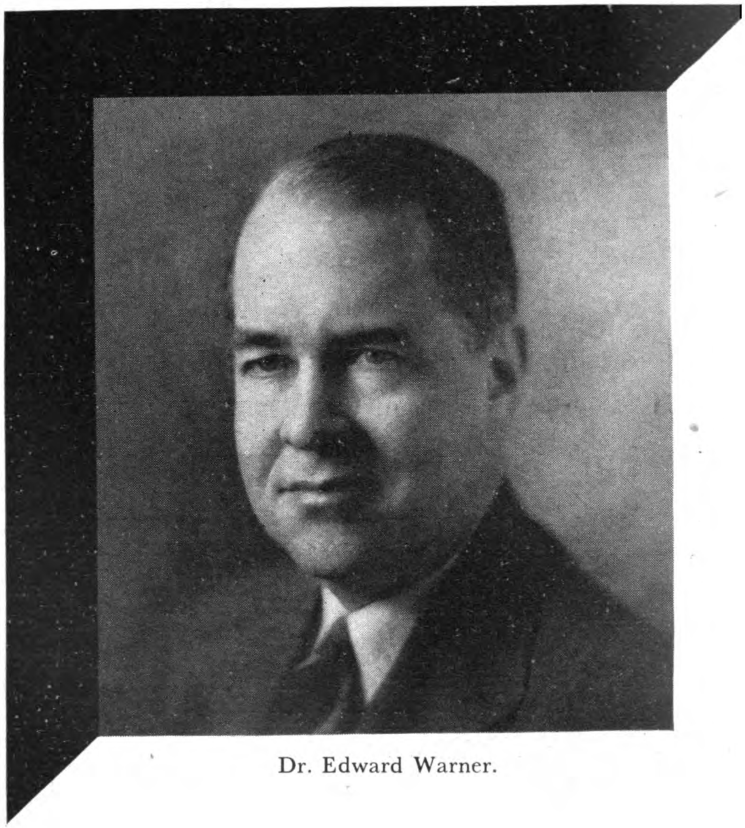
Along with the new format, we have also been able to effect a sharp reduction in the length of time required to produce each issue, thus making it possible to improve the timeliness of its editorial content.

Most of you, by your interest, have indicated your acceptance of the BULLETIN as an authoritative medium for the dissemination of information on all phases of air sea rescue. Its pages will continue to be open to all interested agencies and individuals for the presentation of newsworthy material on this and related subjects . . . and its value will increase in direct proportion to the frequency with which you use those pages. In other words, we shall welcome—and seriously consider for publication—all ideas and articles which will contribute to the subject of air sea rescue.

We are not concerned with composition or writing style—our editorial staff [illegible] *We are interested in basic, factual material . . . and remember, too, that ph*[illegible] *your story are highly desirable. Address your material to BULLETIN Ed*[illegible] *Agency, 1516 Fourteenth Street, NW., Washington, D. C.*

PICAO

INSTRUMENT OF WORLD-WIDE AVIATION UNITY



Dr. Edward Warner.

▶ ▶ ▶ ▶ *If it could be said that one man is the acknowledged authority on all phases of aviation . . . that man would undoubtedly be Dr. Edward Warner, President of the Interim Council, Provisional International Civil Aviation Organization, representing fifty-one member nations.*

Dr. Warner was professor of aeronautical engineering at MIT; Chief Physicist of the National Advisory Committee on Aeronautics; Vice-Chairman of the Federal Aviation Commission; Assistant Secretary of the Navy for Aeronautics. He has been a member of NACA since 1929, and of the Civil Aeronautics Board since 1939.

A Fellow of the Institute of the Aeronautical Sciences; member of ASME; former President of SAE and the American Bureau of Aircraft, Dr. Warner was a recipient of the Wright Medal (SAE) in 1932, and the Aero Club de France Medal (1927) for his contributions in the field of aviation. He has written several authoritative works and contributed many scientific, industrial, and educational papers on aeronautical subjects.

by Dr. Edward Warner
President, Interim Council, PICAO

is just one year since the nations of the world met ıicago to discuss what cooperative means could und for developing international civil aviation for enefit of mankind. It is only four months since ıstrument that was created by those nations, the sional International Civil Aviation Organization, ı to work for the amicable, equitable, and orderly opment of international air traffic.

t the progress made in this relatively brief time rd that objective gives hope that the purpose of ιO will be achieved, and that the world of civil ion will be a unified one.

ıe preparatory phases of PICAO's work have been ılly completed; the framework of the organiza- has been erected; the rules and regulations that guide its activities have been drafted; many of :ommittees that will work under the Council's tion have been set up and have begun to function. ct, PICAO has taken many concrete measures to e that the phenomenal progress made during war in the technical aspects of air transport will not st, now that the military need for these facilities ervices has ended.

broad terms, PICAO has three basic objectives: *to create the best physical conditions for civil , to eliminate the hazards that arise from a lack oper organization of air routes or from failure to agreement on proper organization; (2) to free ıational flying from any obstruction or delay of a nature; (3) to make international air transport strument of good will rather than suspicion and :ct.*

e first objective is primarily a problem of airway ıization, in communication and meterological :es, in aerodrome and traffic control, and other to international aeronautics. It is the purpose ICAO to promote uniformity in all technical :hes serving international aviation. The interna- l standards and recommended practices that its ıittees are establishing will facilitate international ion in all parts of the world.

e second objective is to remove needless delays d in crossing national boundaries and to open orld airlanes to easy passage. In wartime the ge of military aircraft around the world pre- d no insuperable problem. National sover- y, surrendered in the interests of the common for victory, presents different problems when commercial air traffic is involved. Much of the unwieldy bilateral bargaining that would otherwise be necessary between nations if national barriers to aviation are removed is obviated by the International Air Services Transit Agreement, which exists within the same general framework that sets up PICAO. Twenty-three states have accepted the Transit, or "two freedoms" agreement, which grants general and unrestricted rights to free passage of transport aircraft. It presents a true analogy with the freedom of the seas. With the same general purpose, PICAO will collect and analyze reports and information of international air transport. Member states have agreed to supply PICAO with full statistical and financial records, for analysis and publication. This free exchange of information will do much to allay any fears that doubtful economic weapons are being used in the air.

One of the most noteworthy activities of PICAO has been the formulation of a program for regional route services. The organization is sponsoring regional meetings in various areas of the world to evaluate the type and location of air navigation facilities needed for the operation of air services along international routes; to meet the problem of the probable discontinuance in the near future of certain military facilities and services of use to international civil aviation; to apply the international standards and recommended practices developed by PICAO to meet specific situations in the various regions of the world, and to ensure maximum uniformity and availability of services and facilities throughout the world; and to determine whether facilities considered necessary for international air services will be installed, maintained, and operated by the state in whose territory they are, or should be located, or whether other means of support must be arranged where a member state is unable to operate necessary facilities or services by itself.

The regional meetings, it is intended, will develop into permanent regional route service organizations, their work guided by PICAO. It is expected that

they may have a permanent secretariat established by PICAO.

The first regional meeting is being called for the North Atlantic Region by the Government of Eire, which has been the convening state for the Transatlantic Air Service Safety Organization. The attendance for this meeting will be considerably expanded beyond the TASSO membership.

The Governments of France, Egypt, and the United States have been invited to convene succeeding regional meetings; France for the European region, including the Mediterranean area; Egypt for the Middle East; and the United States for the Caribbean region.

The states to be invited to the regional meetings will be named to include those interested on the basis of territorial location within the region for which the meeting is to be called; of actual or prospective opera-

tion of airlines within the region; or of contribution of facilities for international air transport within the region.

In the technical sphere, there has been a large degree of unanimity on what should and what can be done. As a basis for its activities, the Air Navigation Committee has had 12 technical draft annexes prepared by the Chicago Conference on International Civil Aviation.

Four committees—Rules of the Air and Air Traffic Control, Communications, Aerodromes, and Ground Aids and Meteorology—have already reviewed and submitted reports to the Air Navigation Committee on these annexes.

Two other committees—Search and Rescue and Maps and Aeronautical Charts have completed their review of the annexes and are now completing their final reports.

The Search and Rescue subcommittee held its first meeting on November 14, with representatives of several nations in attendance. J. R. K. Main, of the Department of Transport, Canada, was elected chairman of the committee.

As a basis for its considerations of international Search and Rescue organizations it had the Chi[illegible] draft annex L, "Search and rescue, and Investig[illegible] of accidents." This section, because of the gro[illegible] importance of each component of the annex—se[illegible] and rescue and investigation of accidents—was di[illegible] into two separate sections.

With this division, the PICAO subcommitte[illegible] Search and Rescue was left with a single parag[illegible] for a basis of discussion, contrasted with well devel[illegible] annexes for the other divisions of aeronautical ai[illegible]

The absence of a complete Chicago tech[illegible] annex is explained chiefly by the comparative no[illegible] of organized arrangements for Search and Re[illegible] developed almost entirely for military organiza[illegible] during World War II. There have, it is true, numerous maritime rescue services, such as the [illegible] Coast Guard and the Royal National Lifeboat [illegible]tute, but air-land and air-sea rescue services have developed to their present state of organization since 1940.

It was then that the need for military rescue [illegible]ices became apparent and air-land and sea r[illegible] services were placed on an integrated, organized [illegible] When the benefits derived from rescue operatio[illegible] combat zones and along ferry routes became appa[illegible] military services placed rescue organizations into [illegible]ation over the whole world.

The principal air-land and sea rescue operat[illegible] functioned in various and widely separated seg[illegible] of the world: over the "hump; in India; in the S[illegible]west Pacific, where submarines played an impo[illegible] part in the organization; in Alaska, across which p[illegible] a great volume of "lend-lease" traffic to Russia; the Labrador tundra on the Greenland Ice Cap, in the North Sea where the Royal Air Force an[illegible] Eighth Army Air Force cooperated in the most [illegible]tive rescue system in any concentrated area i[illegible] world. Many hundreds of allied airmen owe lives to this great, ingenious, rescue network radiated from the United Kingdom to the h[illegible] shores of Europe.

If the Chicago annex on Search and Rescue brief, it was because the nations of the world ha[illegible] at that time had the opportunity of evaluatin[illegible] tremendous efforts of military rescue organizatio[illegible] had not had time to apply those military experi[illegible] to civil aviation.

The Chicago annex, however, was the basi[illegible] considering the application of the lessons learn[illegible] the operation of military rescue services to int[illegible]tional civil aviation.

e Search and Rescue subcommittee of PICAO xpanded the Chicago annex into a suggested pro- for the nations of the world in developing the e services of the world into a globe-encompassing ork that would save many victims of air crashes death in remote places along the airlanes of the .

common with the other subcommittees of .O, the Search and Rescue subcommitee sub- d a report on standards it thought necessary for iational operations. It recommended that the lards it set forth should be adopted by member so far as possible.

e committee recommended that Rescue Coordi- n Centers be established at or near to traffic con- enters along the international air routes of the ..

e Rescue Coordination Centers would initiate, linate and terminate Search and Rescue opera- The territory to be covered by the Rescue dination Center would be defined by the State or ent States in collaboration to effect efficient age.

ider the jurisdiction of the Rescue Coordination ers there would be established Rescue Units to be d along the air routes used by international air . It is proposed that these units would have ible widely diverse types of trained personnel ac- ng to the regions where they are operating, such pert mountaineers, crash-boat operators, skiers, ists, dog drivers, parachutists for medical first-aid, rne lifeboat rescue crews, and helicopter pilots.

e standards suggested by the Search and Rescue nittee also include recommended practices for ng Search and Rescue operations.

esent civilian facilities for Search and Rescue ties on international airways are very scanty. h and Rescue is a wartime art, developed largely eet military needs. The PICAO Search and ie subcommittee has therefore recommended the United States Coast Guard, and the British Admiralty, and all other agencies now active in air-sea rescue work, be asked to continue to operate weather and rescue patrol activities for civil aviation.

To achieve the maximum cooperation between nations and remove national barriers in Search and Rescue work, it is recommended by the committee that nations undertake to give rescue aircraft complete freedom of movement across borders.

Despite a great expansion in the work undertaken at Chicago in Search and Rescue, PICAO still has much to do to complete the framework on search and rescue operations. It is likely that a meeting of Search and Rescue technical experts will be called to formulate recommendations for standards for emergency equipment to be carried on aircraft, for survival equipment to be dropped to survivors of aircraft crashes until rescue is effected, and for the equipment of the Rescue Unit.

While wartime experience is by no means a fair criterion to apply to commercial aviation, the record of the wartime years in saving life indicates the immense importance of having an organized plan for rescue work in advance of the time when the emergency arises. Such emergencies are fortunately rare in civil flying, but civil aviation authorities can nevertheless learn the value of preparedness from the military experience.

PICAO REGIONAL BREAK-DOWN

The Air Navigation Committee of PICAO recommended that PICAO route service organizations be established in the areas described herewith—recognizing that these areas are not all-inclusive and that further experience may require their rearrangement or subdivision. Because the nature of international air traffic and the problems arising therefrom within a given area determine the necessity for local consultation within the area, no attempt was made to define exact geographic boundaries. Consequently the areas listed will overlap in some cases.

(a) Areas within which immediate action is recommended:

1. *North Atlantic Area.* The area embracing the northern part of the eastern portion of the United States, the eastern portion of Canada, western and northern Europe, and south to include Bermuda and the Azores. (Eire is the convening state.) It is strongly recommended that Eire advance the proposed convening date of the states interested in this area.

2. *European-Mediterranean Area.* The area embracing Europe and the countries bordering the

Mediterranean Sea. (Suggested convening state—France.)

3. *Middle East Area.* The area embracing the countries bordering the eastern shores of the Mediterranean (including Egypt) and the Red Sea, east to and including the western portion of India. (Suggested convening state—Egypt.)

4. *Caribbean Area.* The area embracing the countries bordering the Gulf of Mexico and the Caribbean (including all the States of Central America), the West Indies, the Bahamas, and South America north of the Amazon River. (Suggested convening state—United States of America.)

(b) Areas in which need for early action is indicated but which may require to be scheduled at a later date to avoid conflict with other regional meetings.

1. *South Asia-Australasia Area.* The area embracing India, Southern China, and the lands and islands south to and including Australia and New Zealand. (Suggested convening state—Australia.)

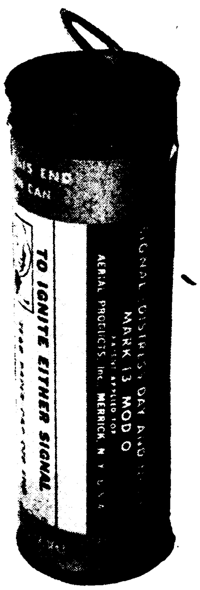
2. *South Atlantic Area.* The area embracing the coast of Brazil, the Guianas, and Trinidad eas and including the west coast of Africa between Fr West Africa and the Belgian Congo. (Sugge convening state—Brazil.)

3. *South Pacific Area.* The area embracing west coast of North America south of and inclu Vancouver, west through the Hawaiian Islands to including the east coast of China south of Shang the Philippine Islands, Australia, New Zealand cluding the islands in the South Pacific. (Sugge convening state—Australia or New Zealand.)

(c) Other areas, the boundaries of one of w are suggested below, should be determined when necessity for establishing PICAO route service ganizations is indicated as a result of increasing traffic and international air navigation problems

1. *North Pacific Area.* The area embracing west coast of North America west to the east of China north of Shanghai and including Hawaiian Islands. (Suggested convening sta United States of America or China.)

DAY AND NIGHT DISTRESS SIGNAL



The Bureau of Ordnance, U. S. Navy, is in process of distributing a new combination day and night, hand-held distress signal as successor to the Mk 1 Mod 1 distress smoke hand signal.

The Signal Mk 13 Mod 0 contains the same orange smoke canister in addition to a pyrotechnic flare pellet for use under night distress conditions. The flare has a burning time of 18 to 20 seconds and an average candle-power of 3000 candles. The weight of the signal is 6.4 ounces.

The following operating data are abstracted from Ordnance Pamphlet 1177.

The signal body carries an illustrated decalcomania which shows in detail the method of operation. The flare end of the tube (for night use) can be identified by a series of embossed projections extending around the case approximately ¼″ below the closure.

The following steps should be followed in the operation of this signal:

(a) Having determined which end of the nal it is desired to use (smoke for day, flar night) remove the paper cap which is glue the original body. (This cap should ordin be removed before the time of actual use.)

(b) Point signal away from face and gi quick pull on the pull ring which will come from the can, thereby igniting the compositic *NOTE: If unable to remove the soldered c this manner, bring the pull ring down ove rim of the can and press down, using the ring lever to break the seal.*

(c) Hold signal at arm's length at an ang about 30° from the horizontal to prevent possibility of hot drippings or discharge fa on the hand.

After one end has been used, the signal shoulc mediately be doused in the water in order to coo metal parts. The signal should then be retaine use of the opposite end when required. Each se of the signal is well waterproofed and insulated ag transfer of heat from one section to the other.

A total of 1,500,000 Mk 13 Mod 0 Signals is u contract. At present these are intended for use, but considerable interest in this new combin signal has been shown by the Army Air Forces as as by Allied services.

the top of the world

"Aviation is recasting our maps, rewriting our geographies and upsetting our sense of direction. . . .

"The Arctic regions already have ceased to be only icy desolation; they are the crossroads of commerce for the next year and the year after, with surfaces and climate rather well suited to their new role"[1]

by Lt. Comdr. M. C. Shelesnyak, H(S) USNR

part I

"There are two kinds of Arctic problems, the imaginary and the real. Of the two, the imaginary are the more real; for man finds it easier to change the fact of nature than to change his own mind."

[2 3] *Vilhjalmur Stefansson.*

The aura of romantic nonsense about the Arctic is a significant example of the result of our reluctance to accept new concepts which tend to disturb our preconceived notions. Fact is rare and fable rampant about that part of the world.

▼

The Pythagorean school of philosophy, which held sway in Greece some five centuries before the birth of Christ, evolved the theory that the earth was spherical and divided into five zones: One torrid, two temperate, two frozen. Accordingly, as one moved from the land of the Greeks southward, it became increasingly warmer until the climate was so hot that life was impossible, and increasingly colder as one moved northward, and also uninhabitable. So firm were the Greeks in their convictions of the correctness of this concept of zones of habitation, that the brilliant achievement 2,000 years ago of Pytheas who sailed beyond Scotland, past Thule (Iceland) to the very tip of Southern Greenland, was ridiculed. The doctrine of Pythagorus obtained until the 15th Century when the genius of Prince Henry the Navigator, of Portugal, sent ship after ship deeper south; and in 1471, Fernandez and Estesves sailed along the west coast of Africa until the high noon sun was at their zenith and found the heat no greater than that in Portugal at times. In 1486, Diaz reached the Cape of Good Hope, and De Gamma sailed around the Cape in 1497 eastward to the Indies, breaking through the iron grip of Pythagorus.

The northward course was more difficult for the cosmographer and the peoples of mediterranean civilization. Yet, as early as the end of the Eighth Cent Iceland was discovered by the Irish; and the I monk, Dicuil, mentioned in *De Mensura Orbis Te* (820 A. D.), the voyage of some of his country from Ireland to Iceland.

Only after the Norsemen took over Iceland from Irish and established a republic around 1000 A. did the story of Iceland become generally know the Europeans. By parliamentary decree, Iceland came a Christian nation, and knowledge of that of the world began to grow. Between the Tenth Twelfth Centuries, the west coast of Greenland colonized. But real progress in exploring and un standing of the North country was ever being styn by what Stefansson aptly terms "the tenacity of herited belief."

In the 15th Century, the most compelling mc of exploration was commercial—the search for trade routes by seaway to the Indies. Columbus lieved that the shortest route to the Indies woulc northwest or northeast. This provoked the long se for the northeast and northwest passages.

In 1845, two fine ships, the Erebus and the Te manned with 129 men from England's "best" fam and led by Sir John Franklin, sailed in search of northwest passage. None returned.

The procession of searches for the lost Fran expedition has no counterpart in history, except haps the search for the Soviet flier, Levanevsky, an crew of five who were flying in a four-engined senger plane, H–209, from Moscow to Fairba Alaska, and were forced down August 12th (or 1 1937. The official search for Franklin lasted 1854, eleven years after the expedition was last h from. For years, the tragic ending of the Fran expedition remained unsolved. When it was at revealed, the horror of starvation, disease (scur and cannibalism was ghastly. The lessons of w men marooned earlier, who lived on meat off land, went unheeded, for such diets were not sistent with the best traditions of the dietetics of homeland.

The Franklin tragedy stifled further Arctic expl tion for commercial ends. But explorers went into the North; but the motive was sport, and quering the Pole was akin to climbing the hig mountains. With this attitude, came the inclina to stress the hardships and dangers. The spi dashes to the Pole were races against nature.

In April 1909, Peary reached the North Pole. Peary traveled as a conqueror rather than geogra

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[1] *C. Hurd, "World Airways" in "Compass of the World," a symposium on political geography by Hans Weigert and Vilhjalmur Stefansson, MacMillan and Company, New York City, 1944.*

[2] *V. Stefansson, "The Arctic in Fact and Fable," No. 51, Headline Series, Foreign Policy Association, 1945.*

[3] *E. Hanson, "Prophet of the North," a biography of Vilhjalmur Stefansson.*

ıologist; he had no desire to seek out the secrets ·ing off the land." Rear Admiral Richard E. (then Lt. Comdr.) of the U. S. Navy, as navi- and Floyd Bennett, pilot, flew over the North n May 8-9 in 1926, in a Fokker monoplane, the ›hine Ford." Yes, the Pole was conquered.

vever, early in 1906, a young explorer began one first truly scientific programs for unveiling the ›ries" of the Arctic. Vilhjalmur Stefansson, ›pologist, explorer, ethnologist, began the study in the Arctic by living with the Eskimos and ıg to live off the land. No single person has more to enlighten the world on the friendly . Stefansson has taught that although the has certain real difficulties and dangers, they : overcome by understanding them; and under- ng the North country is vital since that part of obe is truly the crossroad of the world of to- w. Years before the first flight over the pole, sson, in an article in the National Geographic zine (1922), presented the significance of great flying over the Pole. "The Friendly Arctic" [4] shed in 1921) was a pylon firmly planted by sson for redirecting our archaic beliefs and for- ng a proper understanding of the Polar Sea as iterranean sea and of the geopolitical meaning Arctic.

: theories and practices of Dr. Stefansson have ! a significant part in our understanding of the and sub-Arctic; the stellar work of Sir Hubert ıs and later, he and Carl Eielson together, gave ›rld a tremendous amount of information about flying. The voices of Stefansson, Wilkins, and ı were not unheard; but heard only in whispers. ›8, the airlines of Alaska flew 80 percent as many s as those in the States, although there is but laskan, including Eskimos and Indians, to every inhabitants in the States. In general, however, ve been slow to exploit the North country, and ›ssons which we had to learn during World War ·e difficult because of our reluctance to change herited beliefs. Of the present status, Stefans- ·ites:

1930 leadership in polar exploration had passed west Europeans and North Americans to the of Soviet Socialist Republics. No one was any longer concerned about merely getting to the Pole; for after Peary, it had been visited once by airplane and twice by dirigible. The program of the Arctic pacemakers was not economic, scientific, political. So when a Soviet expedition went to the North Pole, it was primarily for technical study. Four 4-engined airplanes under the command of Professor Otto Y. Schmidt, at that time Chief of the Administration of the Northern Sea Route, took off on May 21, 1937, from their most northerly Arctic Station—on Rudolf Island—and flew about 500 miles to the North Pole and just beyond it as viewed from the Old World side. The airplanes and most of the personnel returned to Moscow, after depositing equipment and supplies, leaving a party of four scientists. The commander was Ivan Papanin; the other members of the party were Ernest Krenkel, Peter Shirshov, and Eugene Feodorov.

"As soon as the Papanin group had leisure, they took walks some distance to where the ice had been cracked by differential stress. There they saw seals swimming around in the water, gulping down shrimps that were floating near the surface. The camp was visited by many birds of several species, and the explorers came to recognize this as the ordinary pattern of life at the Pole.

"Later, using the ordinary technical procedure of marine biology, they lowered traps farther and farther down into the water, opening them and then closing them at greater and greater depths and bringing to the surface the captured plant and animal life. Thus they established, all the way from the surface to the sea bottom about two and a quarter miles below them, a life gradient similar to that of the North Atlantic, from which indeed the polar sea is a gulf.

"The visit of a mother polar bear, with her two cubs so small that they obviously must have been born on the ice right near the Pole, completed the overthrow of the doctrine that there is a northern line or limit beyond which plants and animals do not go."

More travel and study of the Arctic has been carried out by men in the past two decades than in the previous two thousand years; and this because more information about the climate and geography and means of travel has been collected. Stefansson's "My Life With the Eskimos" in 1913,[5] "The Friendly Arc-

Stefansson, "The Friendly Arctic," MacMillan and ny, New York, N. Y., 1921.

[5] *V. Stefansson, "My Life With the Eskimos," Macmillan and Company, New York, N. Y., 1919.*

tic" in 1921, and Admiral Peary's "Secrets of Polar Travel" [6] were landmarks.

We learn that the Arctic is neither barren wasteland nor eternally violent with gale and storm. And we are at last breaking away from Mercator—who still serves his purpose well—and accepting the global aspect of the world. The tragedy of the Soviet flight in 1937 under Sigismund Levanevsky stimulated the most extensive flying over the Arctic in history. Search from the air by three nations, the United States, Soviet Union, and Canada, with help from Great Britain and Scandinavia, though unsuccessful brought many advances in polar aviation, Arctic exploration, and meteorology.

This brief glimpse into the history of the Arctic is given only to outline the course of our beliefs, which were chiefly mistaken. A complete story, fascinating as the best of adventure stories, would be beyond the scope of this article. We are concerned with problems of flying in the Arctic with particular emphasis on the aspects of rescue and survival. It is vital to understand that the various conditions of the north are closely interrelated; whether one deals with surface transportation, aviation, rescue, or survival. There is no separation of essential information. Knowledge and understanding of the Arctic and sub-Arctic are absolutely essential. With them, the real problems can be handled and the imaginary ones fade into nothingness.

THE NORTH COUNTRY

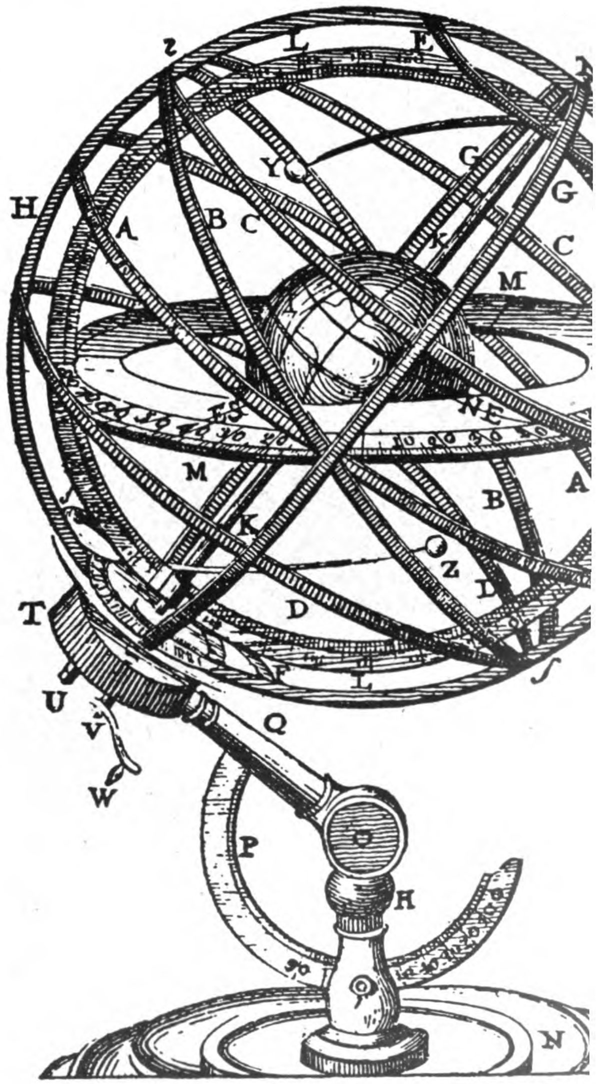
What is the Arctic? The Far North is divided into the Arctic and sub-Arctic on the basis of climatic differences—not by the Arctic Circle. The Arctic is the region in which the average temperature for the warmest month is less than 50° F. This roughly coincides with the tree line or the northern limit of forest. It includes the northern coasts of Alaska, Canada, the Canadian Arctic archipelago, much of Labrador, most of Greenland, the Svalbard archipelago, northern Siberia, and the Arctic Ocean.

The Arctic Ocean covers approximately five million square miles, about one-thirteenth as large as the Pacific Ocean. Surface water ranges from 28° to 32° F.; and towards the end of summer, pack ice, seven to ten feet thick covers two-thirds of the sea. It is a mediterranean sea separating Eurasia
North America.

Siberian Arctic consists of a belt narrow in the
and broadening eastward to include the basins o
Ob, Yenisei, and the Lena, north-flowing ri
These basins are comparable in size to the Missis
River basin. The coast of Siberia has no glacie
the mainland, and large areas are free of snowb
The Franz Josef Land is a group of ice-cov
plateau-islands in the northern and western re

The Svalbard archipelago lies between Norway
Greenland. Spitzbergen, the chief island, is a pla
with many deep fjords. There are mountains i
east and south, plains in the north and west. E
for the southern interior, the valleys are filled
glaciers.

Greenland, the largest island in the world, is a
700 miles at its widest and 1,600 miles long,



[6] *Robert E. Peary, "The Secrets of Polar Travel," Century, New York, 1917.*

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rise mountain ranges from 7,000 to 12,000 feet More than three-fourths of the island is cov- ith an ice cap—only the Antarctic cap is -which is 8,000 feet deep at the center. The of the cap has many deep crevices, and the re the most rugged in the northern hemisphere. glaciers extend to the coast from the ice cap, lischarging ice into the sea.

of Greenland's coast extends beyond the ice xcept northwest and northeast Greenland the cap extends into the sea—and is moun- with many fjords cutting deeply into it. This is hazardous and difficult for surface travel.

heastern Labrador is much like the eastern an Arctic, mountainous with treeless pene- fjords, and formed of granite or gneiss.

dian archipelago, perhaps better considered rt of eastern Canadian Arctic, includes Baffin lesmere Islands. It is, in general, high and with many glaciers and well developed fjords. ck covers the higher regions, and tundra, the reas. There are numerous islands ranging in to Baffin Island, which is about 2½ times as Great Britain. Eastern Canadian Arctic also s the coast of Boothia Peninsula to Labrador. ern Canadian Arctic is distinguished from by the difference in topography and also by t that each section is approached from differ- ections with little or no travel between them. n Canadian Arctic comprises mainland from cation Point to Boothia Peninsula and that the archipelago north of it, including Vic- land (the size of Great Britain), Milville, and Islands. The mainland is, in general, low nd rocky with few mountains, and therefore, iers, and for most part, prairieland.

ne Arctic Alaska, the Brooks Range, which from 7,000 to 10,000 feet, cuts across the n tip of Alaska to form a level triangular Waters flow southward to the Yukon and rd to the Bering Sea. The range, which con- many mountain groups, offers a formidable to travel, but there are many low passes and The prairie north of the Brooks Range is only wenty miles wide from shore to foothills on the n-Canadian border, but reaches a width of 200 orth-south at Barrow. The Arctic coast of is generally flat and low, except for the vicinity of Cape Lisburne and the ports of the Seward peninsular.

The sub-Arctic includes a great deal more territory. Most of Alaska is sub-Arctic and is comprised of two regions differing in topography and climate, the coastal region and the interior. The coastal region consists of the south coast of Alaska, the Alaskan Peninsula, the Aleutian Islands, and the region south of the Seward Peninsula. The territory south of the Seward is low-lying and includes the deltas and alluvial plains of the Yukon and the Juskowim Rivers. The Aleutians form an almost perfect arc of rugged volcanic islands stretching across the Northern Pacific to Kamchatka. Altitudes of 4,000 to 5,000 feet and higher are not uncommon. The weather of these "stepping stones" from the American continent to Asia, because of its relative low temperature, forms a dangerous fog bank which makes flying much less safe than routes to the north. The Alaskan Peninsula, which is the northeastward extension of the Aleutians, is similar to the islands in general character. The south coast of Alaska is very mountainous, but without volcanoes. The mountains reach peaks of 18,000 and 19,000 feet.

Interior Alaska includes the Alaska Range, which is an extension of the mountains of the southern coast and includes Mt. McKinley, the highest peak in the North American hemisphere, 20,300 feet. The broad valley of the Yukon, a river 2,000 miles long, a major waterway of the world, is very fertile in many places.

Sub-Arctic Canada includes a large section of the mainland, even some parts of the north coast. The mountains of Western Canada and the Mackenzie River Valley, and the broad flat country east of it, form its major natural divisions. The mountains of western Canada include the Mackenzies and the northern extension of the Rockies. Some peaks are covered with snow all year and reach altitudes of 8,000 feet. The Mackenzie River is navigable from early July to mid-September for steamboats from the Arctic Sea to Fort Smith about 1,300 miles. This valley is fertile, well forested, and rich in mineral and oil. Lakes are scattered throughout the region of the Mackenzie Valley. The flat plains east of the valley slope southward to Hudson Bay. The northeastern part is barren, truly arctic, but the broad basin around James Bay—southern extension of Hudson Bay—is

forested and has myriads of lakes. The area has some of the richest mines known.

Sub-Arctic Labrador is forested and nonmountainous and merges with the interior lowland of Canada. (The sub-Arctic region of Siberia is not included in this discussion).

The Northern Seas comprise the Arctic Sea, parts of which are locally named as Beaufort Sea, north of Alaska; Barents Sea, east of Novaya Zemlya; Eastern Siberian Sea, north of Siberia; Greenland Sea; Baffin Bay, and Hudson Bay, Bering Sea; and Kara Sea.

The Arctic Ocean fills the Arctic Basin, occupying the central part of the polar region. A shallow continental shelf surrounds the Arctic Basin at a depth of several hundred feet, and varies in width from sixty miles off Point Barrow to about 430 miles off Siberia at the New Siberian Islands. Most of the Canadian Arctic archipelago lies on this shelf. The edge of the shelf drops off abruptly to depths of several thousand feet. The deepest soundings in Polar Basin were taken by Wilkins in 1927—17,843 feet at 77°45′ N., 175° W. A sounding of 16,990 feet without bottom was taken at 86°30′ N., 39° E.

The ice of the Northern Seas is of two kinds: *pack ice*, which is constantly moving; and *fast ice*, which is immobile. Both are frozen sea water and initially salt, but become progressively less so. Pack ice, even towards the end of summer, covers two-thirds of the Arctic Sea. The pack ice is ever moving, its floes breaking up and drifting about by the effect of winds and current, with leads (open cracks from a dozen yards to several miles in width), opening and closing between various floes. Pack ice includes ice cakes varying from a foot to several hundred yards in diameter, to great ice fields miles in diameter. As the pack ice is continually moving, narrow lanes and leads develop. Although leads develop even in winter, they freeze over during that time of the year. At times, the floes are pushed together, and the slow crushing piles up ridges and hummocks. Pack ice varies in thickness, but is normally from seven to twelve feet thick. The surface may be smooth enough for aircraft landings, especially on frozen-over leads, or it may be ragged enough to make even sledge travel impossible.

Fast ice forms in bays and straits where, free of strong currents, it remains immobile, except when it breaks up in the summer. Such ice usually a[illegible] good emergency landing fields.

The weather of the Arctic is perhaps more mal[illegible] than any other aspect of the North country. [illegible] hjalmur Stefansson's comments are particularl[illegible] propriate to these notes on Arctic weather. In [illegible] Arctic, Fact and Fable," he writes:

"In its handicapping power second only to the [illegible] that life is not possible in the remote North is th[illegible] plementary view that ordinary human beings [illegible] not like it. This general view comes under a nu[illegible] of specific headings, among them that it is too c[illegible] winter, that it is not warm enough in summer, th[illegible] absence of sunlight in winter has a depressing [illegible] on the human spirit, and that, in any case, activ[illegible] the North is possible in summer only, the winters [illegible] a time of confinement, a sort of hibernation.

"As to the intensity of cold, it is fairly well a[illegible] that if you were to spend a whole year at the very [illegible] Pole, latitude 90° North, or even a whole centur[illegible] would never observe a temperature colder tha[illegible] below zero. Make it −60° to be liberal; three [illegible] in the Union, according to 'Climate and Man,[illegible] 1941 Yearbook of the Department of Agriculture[illegible] records of that cold or colder. They are Wyo[illegible] −66°; Montana, −63°; and North Dakota, [illegible] There are people living at the special cold spots in [illegible] states some of whom will tell you that they lik[illegible] climate.

"We know that on the whole Arctic coast [illegible] North American mainland there is no weather b[illegible] record as cold as −55° or colder. These are, in [illegible] tion to the ones already named, Minnesota, −59[illegible] South Dakota, −58°.

"As you go south from the north coast of the [illegible] land, whether in the Old World or the New, t[illegible] treme minimum temperatures of winter get lowe[illegible] lower until you have passed out of the Arctic in[illegible] north temperate zone. So far as we know at pr[illegible] the coldest spot in North America is at or nea[illegible] Good Hope, on the Mackenzie River, about 20[illegible] south of the Arctic Circle, with a minimum rec[illegible] 79° below zero. In the Old World, the coldes[illegible] is Oimekon, in Yakutia province, about 150 miles [illegible] of the Circle, with temperatures colder than 90° [illegible] zero, meaning something lower than 120° [illegible] freezing.

"Continuing farther south, whether in North [illegible]

beria, the lowest temperatures are progressively ınd higher; but as we have said, you have to nd through the state of Wyoming in North ı, and correspondingly far south in the Old to reach a point where it is less cold on the day of the year than the lowest theoretically record at the North Pole.

are talking of low, level country in this entire ›n, for we are concerned with places where men can live, not with mountain tops. However, in tops are not at all times colder than valleys. in heights are relatively cool during summer comparatively warm days in winter; but on any : is colder than 40° below zero in the valley you : to find it growing warmer gradually as you near-by mountain slope.

is it true, as formerly believed, that places ıre very cold in winter are also very cold in . The cold pole of our earth, so far as we at Oimekon; and this town is in a forested dis-ith some of the land in grain fields. Experi-stations of the Soviet Government may not be ; wheat; but according to our information, s of some years back, the farmers around the le were raising barley, oats, and rye.

:n I first went north down the Mackenzie River, , I found at the cold pole of North America, od Hope, not merely a beautiful garden but the tion that potatoes from it were shipped down-for the trading posts of Red River and Macken-:r and also upstream, southward. Today po-re grown both south and north of Good Hope preeminence as an exporting center of garden : has disappeared; but the fact remains that, ie latter part of the Nineteenth Century, the le of North America has been well known for table and flower gardens.

at heat in the Arctic summer is found only on ›w-free land; and excepting Greenland, more) percent of all Arctic land is snow-free in Greenland is a mass of ice because it is a mountains, but even in Greenland 15 percent of the land is low enough to be ice-free. Peary ıt the north tip of Greenland, is one of the ice-free parts of this island continent. Peary :re in summer and reported bumblebees and ies among the flowers just back of the most ly coastline in the world.

"It is never hot out on the polar sea, for the drifting ice and the cold water act as refrigerators; but it thaws even at the North Pole in midsummer and it rains instead of snowing. The Papanin expedition, in the immediate vicinity of the Pole, had their first rain of the season on June 28 and the last one on August 26.

"We have disposed, then, of the first two points we just raised. The Arctic cannot be too cold for human habitation in winter, for if it were, a number of our forty-eight states would be uninhabitable; it cannot be so very cold in summer or they would not be raising grain at Oimekon and potatoes at Good Hope.

WINTER IN THE ARCTIC

"But is the absence of the sun depressing to the human spirit and are conditions generally such that you would go into a gloomy sort of hibernation for the winter? We consider the last of these points first.

"Up to and including the expedition of Sir Edward Parry, who wintered in uninhabited Melville Island during 1819–20, it was the general belief that polar exploration would necessarily consist of active summers and hibernating winters. We have already mentioned how the first Parry expedition confirmed this by going into a kind of winter house arrest. But his second expedition, a few years later, was in a country where there were Eskimos. Parry and his men soon found that the Eskimos liked to travel in winter and that white men could travel also. From this time on, the idea that winter is a good period for northern travel developed, though slowly. Twenty-five years later John Rae, of the Hudson's Bay Company, was apparently the first to believe, argue, and show by his own example that winter is a good season for long journeys. He failed to make any substantial number of converts even among the explorers. It remained for Rear Admiral Robert E. Peary to demonstrate to the satisfaction of his fellow explorers of the Arctic (though not to those of the Antarctic) that winter is the best traveling season of the year.

"Peary laid it down as a principle that in the Far North summer is for preparation, and in that sense for

idleness. The favorable time for long journeys, when the ice is strong enough to travel on, starts, according to Peary's view, in January, the second coldest of the months, or in February, which is the very coldest. Overland travel, or travel upon the frozen sea, would close in May or early June when the snow begins to thaw in very high latitudes.

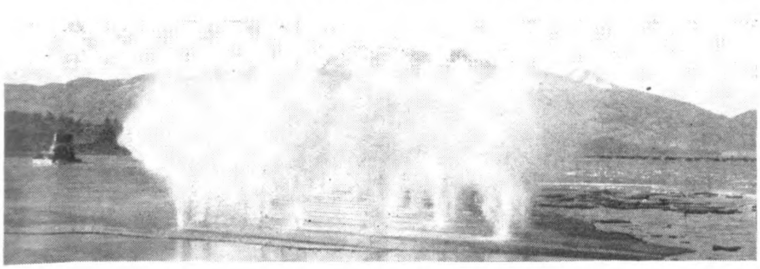
"The rule seems to be that you find in any part of the world a preference for the sort of climate to which the people there are the most accustomed, this preference being the more clear-cut the more uniform climate. Confining ourselves, then, to continental weather, which is more seasonal and less variable than that of northerly islands, we can lay it down as a safe bet that if in a given section the summer is longer than the winter, then the majority of the people living there are going to prefer the summer. But, if, as in Arctic Canada, Alaska, or Siberia, the winter is notably longer than the summer, a majority will prefer the winter.

"The proponents of summer will grow in number as you go south; those who prefer winter increase in percentage as you move north. The dividing line in North America is probably about the middle of Canada, somewhere near Great Slave Lake. In Alaska it is no doubt farther north, for Alaska is a peninsula and the ocean is permitted to give the southern part of the territory what is in effect an insular climate.

THE ABSENCE OF SUN

"We come now to the last of our four points, the idea that the absence of the sun in winter has a depressing mental effect. We have, by implication, dealt with this common belief of Europeans; now we deal with it explicitly.

"It is during the absence of the sun, as we have brought out, that overland and over-ice travel find their ideal conditions. Good travel conditions are particularly a requirement among hunting peoples, who must follow the game. This is easy in winter, when you can use dog sledges; it is difficult in summer, when the dogs carry packs and the people carry back loads, a cumbersome and laborious mode of travel.



"The main transportation differences betwee seasons is that you can walk on water only whe frozen. In the summer boats can be used on lakes or deep rivers and on the sea; being rest to these channels is troublesome to the hunte the caribou do not obligingly travel along rivers shores, or coasts, but tend to be on the open far from the large water courses.

"In the whole North, and southward from the dle of Canada, the land on which grow the p grasses, as well as the trees of the forest, is perma frozen when you get down a few inches or at n few feet, and from there down in some cases to a five hundred feet beneath the surface. Wherev subsoil is frozen, there cannot be any underg drainage. This means that on level or rolling anywhere except on mountain slopes, there is may seem an incredible number of lakes; the s of the country in vast acreas is half water, in large districts as much as 60 percent water. lakes, many of them shallow, are connected freq by sluggish river channels.

"Not only do you have to detour in summer you come to a lake; you may detour in the direction and find yourself an hour or two later tip of a peninsula. Moreover, even if the frost six or eight inches down, your feet keep slippin mud-filled cracks between the hummocks of v tion, and the clay is likely to stick to your feet, n them heavy and tiring you out.

"Primitive Arctic man, therefore, does most traveling and a large part of his work in winter, in a few special districts. European man soon the same practice."

The Arctic is defined on the basis of tempe In the North American hemisphere, all regions the *average* temperature of the warmest month F. or below and the *average* annual temperat 32° F. or below.

It may be well to repeat that the coldest in the Northern hemisphere is not in the Ar remember the definition states *average* temperat the basis for delimiting the Arctic. The colde is in the sub-Arctic, some 200 miles south Arctic Circle; and often North Dakota, Wyo and Montana have lower temperatures than usually found in the Arctic.

Just as the coldest spot in the world is not

neither is the windiest. Less than fifty miles ortland, Maine, on Mount Washington, are he strongest winds in the Northern hemi- Though wind direction and strength gen- ary a great deal in the Arctic, polar pack ire less severe than inland ones. Seasonal is are very different in different parts of the Summer winds along Arctic Alaska are light ttle compared with other regions, while in Canadian Arctic, the summer easterlies are t. Autumn winds vary less, but are more n the Eastern Arctic than at any other time ear. In the Western Arctic archipelago (and Greenland), winter is the windiest season, e Canadian Arctic at this time has less severe han either summer or autumn. On Baffin pring is the windiest season.

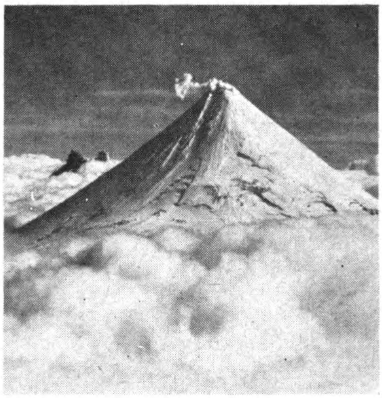
s, however, need not be very strong to become d to the Arctic traveler. Aside from cold, the and blowing of snow can make travel diffi- not impossible. Winds of 15 miles per hour e snow 20 to 25 feet high, and above 30 miles ir, cloud-like swirls to 100 feet high. Drift- w is common, but in open country usually ard.

and snow are not common in the North coun- l the mean annual precipitation is less than ies, which is about the same as semi-arid United States. The Aleutians have an nce, 60 inches, but that is unusual. Summer ing, to a slightly lesser degree, are generally the of greatest precipitation. The Soviet Group Papanin, which drifted from the polar cap to nd, reported rain at the Pole from the end of the end of August.

ite of the low precipitation the Arctic, except ocky areas, is practically all swamp. This is he extremely poor underground drainage, and y small amount of evaporation in the Arctic.

e Arctic fog parallels the snow in frequency nsity; both are most common in the spring. ogs are dependent upon the relation of warm nd over cold sea in the summer, and warm d over cold land in the winter. But over- his is a general seasonal variation, and most is the fact that coastal fogs are fewest during g Arctic winter. Polar pack fogs are almost absent from December to April. There are special types of fog which warrant the particular attention of flyers.

Ice fog, or spicule fog, consists of very fine ice crystals. This fog is rare and is found chiefly over

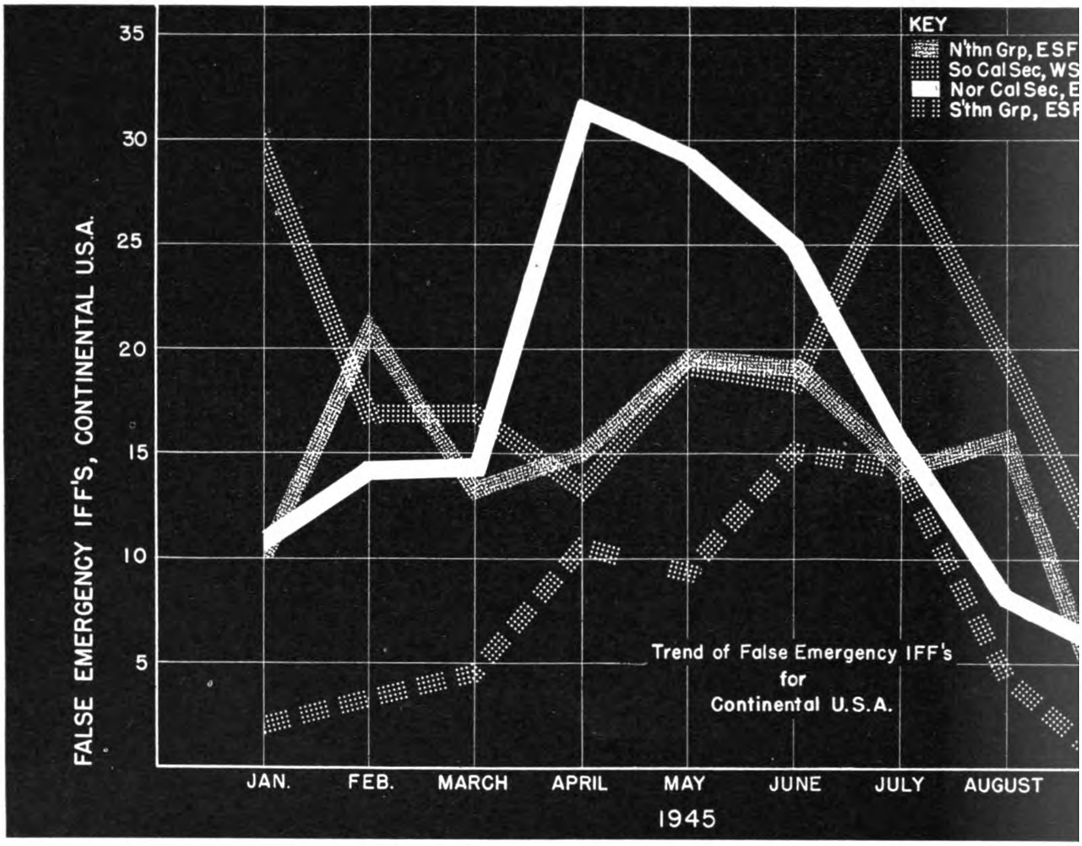


inland ice, especially the Greenland cap. It is hazardous for flying, and in at least two instances produced such a heavy frosting that the aircraft came down out of control.

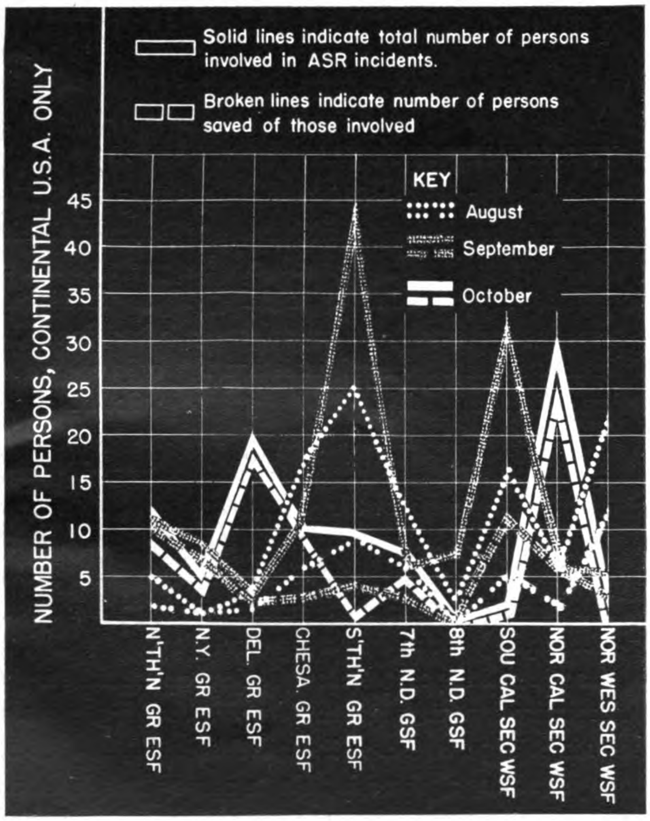
Water smoke is caused by open bodies of water in very cold weather, especially over flooded rivers or large Arctic lakes, which are so deep that they freeze over slowly. When the water freezes, the fog is no longer generated. Sea ice never freezes over completely. It is constantly breaking up into floes.

This description of the geography and climate of the Arctic is far from complete. Anyone who plans any transpolar flying or travel across the Arctic should study them in greater detail. They are intended merely to give a general concept and to debunk the "frozen hell" concept of the Arctic.

Part 2 of Lt. Comdr. Shelesnyak's story—*in which he discusses life and survival in the Arctic—will appear in the March issue of the Bulletin.*



False Emergency IFF's



Prepared by the Air Sea Rescue Agency

From the accompanying chart, it is indicated t false emergency IFF's, the bane of every air rescue organization's existence, are definitely on wane. While part of the decrease may be ascri to the natural reduction in over-all training operati following the end of the war, it is believed that c tinual emphasis on the dangerous aspects of the pı lem has begun to yield dividends.

In the chart referring to the number of persoı involved in air-sea rescue incidents within the c tinental limits of the United States, it will be s that a mean quite close to that of the past is bı maintained. The busiest sectors continue to be Northern and Southern California Sectors of Western Sea Frontier and the Southern Groups of Eastern Sea Frontier. Air-sea rescue task units maintaining their record of rescuing a high percent of personnel not killed or seriously injured.

Aircraft, spotting isolated levee breaks, are able to alert districts in the path of the flood and prevent difficult rescues.

ircraft in flood control

ood areas present many search and rescue problems of a distinctive nature. Here the objec- comes one of preventing the need for rescue han one of actual transportation of persons in- . The use of aircraft for rescue work in flood urrounding tributary streams, water sheds and river valleys is comparatively new, yet it con- najor potentialities for future flood control and operations. Due to the dramatic and extensive and rescue operations over the oceans, jungles, ctic wastes during the war years, flood relief ies have gone almost unnoticed. Now that , personnel, and equipment can be diverted var theaters, the use of aircraft for rescue work d areas may well become a major search and activitiy.

duties of aircraft engaged in flood control re threefold: (a) patrol and survey; (b) emer- action; (c) rescue and evacuation.

PATROL AND SURVEY

During the period of rising waters along the various rivers, and before a critical stage is reached, air patrols are of inestimable value. Larger rivers are watched and recorded by existing shore facilities. However, the smaller tributaries are often inaccessible and reports from aircraft are the only accurate information available. Daily patrols are able to make surveys that enable ground forces to predict a future emergency condition at a particular point and to be prepared to meet the situation when it develops. During the flood stage, these air patrols spot breaks in the levees and alert ground forces. Because areas which cannot be seen from surface craft on the river can be rapidly covered by air, patrol planes also direct surface vessels to persons in need of evacuation through communication with ground forces. During critical periods of high water, or in flash floods, when time is at a premium, a plane is able to survey hundreds of

miles in a relatively short time. Information gathered on these surveys and relayed to communities ahead of the flood crest gives ground forces time for evacuation and prevents many problems incident to rescue work in high waters.

EMERGENCY ACTION

Once the flood stage has reached its peak rescue planes are valuable for emergency action. Key ground personnel are transferred from point to point when surface transportation facilities are inoperative or too slow. Planes are used to advantage for the delivery of needed supplies or emergency equipment to isolated areas. Urgently needed items are delivered in a few hours where normal transportation would require a much longer time, or would be impossible, due to rail and highway failures caused by floods.

Rescue planes also keep a sharp lookout while over navigable waters. Aids to navigation observed to be adrift, missing, or out of position are noted and as a result repair work is started at once before serious accidents result. Derelicts or other hazards to navigation are also identified and reported.

RESCUE AND EVACUATION

Due to the hazards incident to fast currents, floating debris and hidden dead-heads in the flood waters, water landings are not made if some other means of evacuation exists. Surface craft and ground forces are contacted and conned to the scene by plane, when possible. Smoke bombs, float lights, and other pyrotechnics are utilized as necessary. If no other adequate facilities are available to conduct the rescue, the pilot, taking all factors into consideration may, at his own discretion, land and effect a rescue.

Thus, while it is not usually feasible to land and take off regular types of aircraft in flood waters, the helicopter has earned a definite place for itself in flood relief operations. Numerous highly successful tests of helicopter operations were conducted at scenes of flood activity during the past few years.

On April 14, 1945, near Montgomery, Louisiana, boats unsuccessfully fought nine hours to reach a group of seven marooned inhabitants. A helicopter effected their rescue in a matter of minutes without the slightest difficulty.

During the spring floods of 1945 helicopters were used to cover the entire length of the Mississippi River from St. Louis to New Orleans and performed favorably in making detailed surveys of otherwise inaccessible areas as well as effecting actual rescues. During this time, numerous tests were conducted of the helicopter's operations at various scenes of flood acti Landings and take-offs were made satisfactoril flood waters running 6 to 8 m. p. h., and levees a top of 8 to 10 feet in width proved to be a suit landing spot under all conditions.

The usefulness of aircraft for flood control relief work is past the experimental stage. It is to contemplate that an increasing number of det ments of amphibious aircraft will be assigned for f relief duty.

A member of the ground crew takes aboard a boy and hi who have chosen to sit it out together.

PICTURES WANTED . . .

Subscribing to the ancient Chinese proverb "One picture is worth 10,000 words"—the Bul is endeavoring to increase the size and variety c photographic files. Wider use of pictures, we will make for more readable, more interesting art Pictures of actual search and rescue operations, t ing activities, equipment, new methods and niques—anything that will contribute to telling pictorial story of search and rescue—are des Technical or artistic excellence is not a requis let us be the judges of the picture's usability. If sible, include negatives, which will be handled fully and returned promptly. Mail to Bulletin Ec Air Sea Rescue Agency, 1516 Fourteenth Street I Washington, D. C.

Designed primarily for air-sea rescue work, the airborne loudspeaker, developed by Radio Corporation of America for the Coast Guard, is intended to provide a means of communication from a plane in flight to nel either in the water or on land who have no receiving apparatus. Although developmental status, a 500-watt airborne public-address unit recently was tested at the air station in Elizabeth City, N. C., to determine the efficacy of ower unit over a previously tested and comparatively ineffective 250-watt . Test results were favorable and further development authorized.

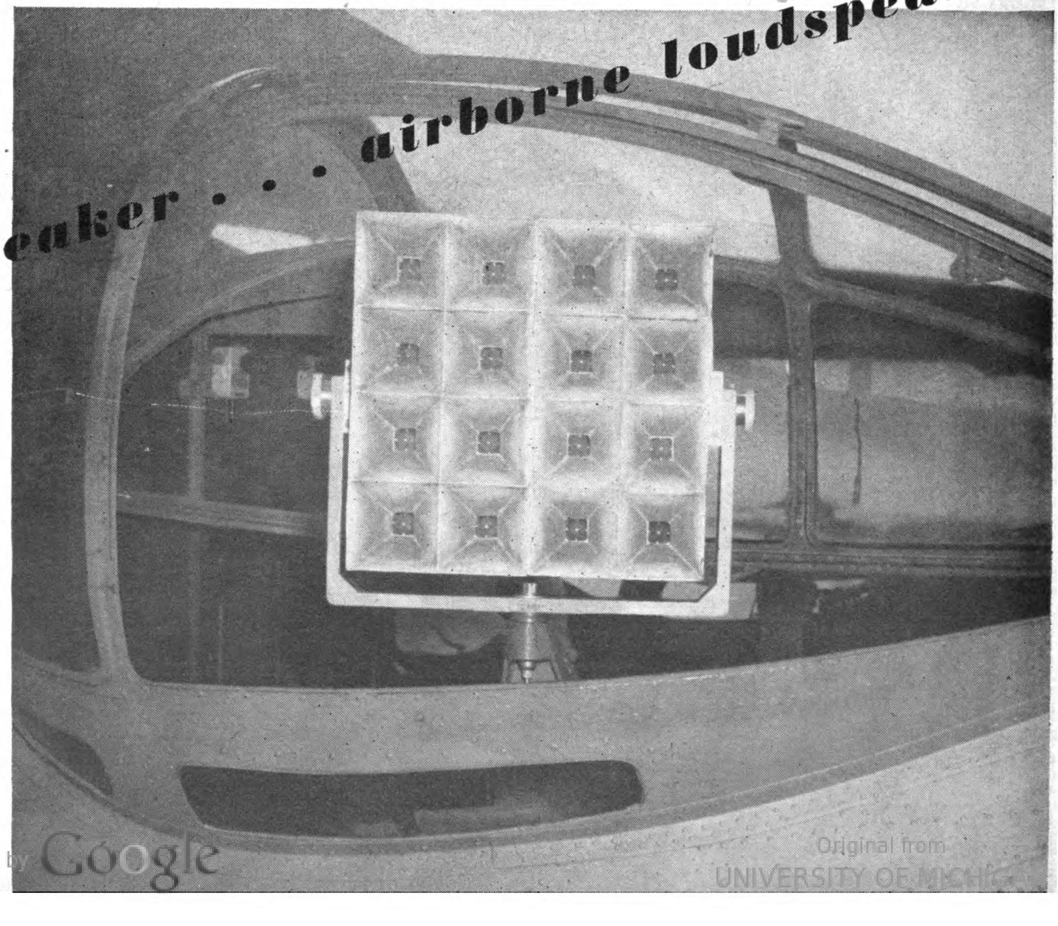
quipment was installed on successive days in both PBY5A and a PBM–3S. eaker was mounted on a standard 50-calibre machine gun mount in the port of the PBY5A and in the waist hatch of the PBM–3S. When the PBY5A was he amplifier was set on a bunk, and the microphone and control box were ed to the navigator's compartment. Two of the RCA engineers were aboard ne to operate the equipment. The pilot was instructed to fly at various dis- and altitudes from the observing ground party.

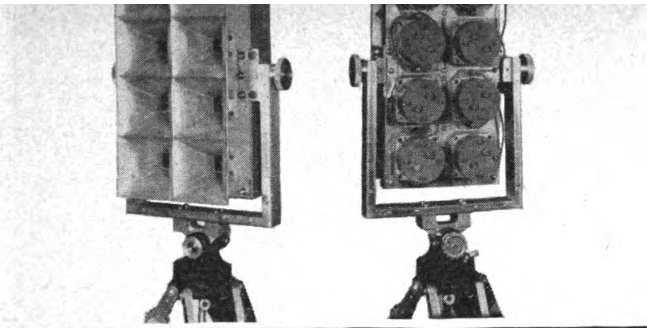
ith the 500-watt system, it was found possible to circle the sound objective at s of one-half to one mile and maintain continuous conversation. Another age of the higher power was that the plane could stay at a distance from the objective so that the interfering propeller noise was no problem. This was e because the lower frequencies of propeller noise (approximately 100 cycles) enuated much more rapidly than the frequencies used in the loudspeaking sys- pproximately 400 to 4,000). Several times the plane passed the observing t distances as great as two miles and retained 100 percent intelligibility.

t the end of the first day's tests with the 500-watt system some slight modifica- ere made in the equipment to raise the frequency response cut-off of the er in an attempt to cure what RCA engineers termed "velocity modulation," tends to occur when developing high power at low frequencies. Also some lty with the dynamotor relays was corrected.

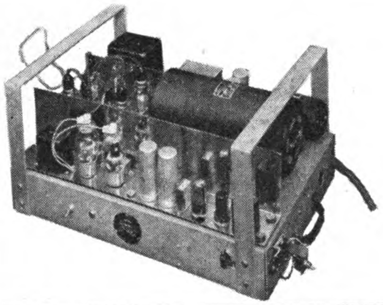
500-watt reproducer installed in port blister of PBY5A.

loudspeaker . . . airborne loudspeaker





Reproducer shown above consists of 250 watts. Eight units pictured here.



Amplifier assembly. Weight approx. 100 lbs. Size 16" x 23" x 12".

Portable Transmitter

To facilitate the following day's tests, continued in the PBY5A, radio equipment was installed in a command car used by the observing party. The plane "talker" was wearing headphones connected to the plane's radio, and it was possible to make direct requests pertaining to the operation of the equipment and the manner of conducting the tests. The "talker" often answered directly to the ground via the speaker system. Results were adjudged excellent. Information obtained was of primary interest to the engineers from a design standpoint and for use in preparing specifications and design refinements.

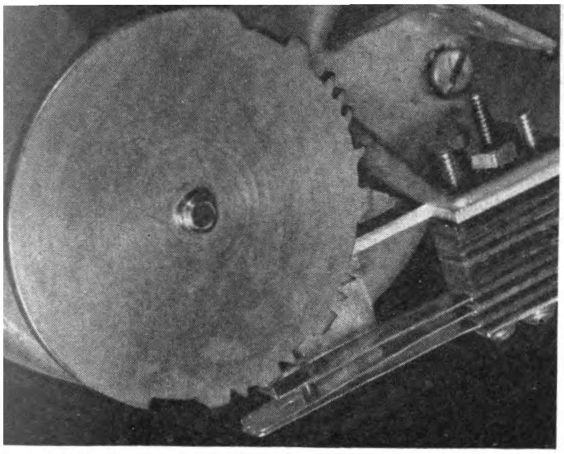
When tests were made using the equipment in a PBM–3S, the results were similar to those obtained in the PBY5A. It was found that the turbulence near the mouth of the loudspeaker could be reduced to a minimum through the use of the spoiler board v originally was installed for protection of the gu *Keeping the loudspeaker in quiet air is one o prime considerations in guaranteeing the succ operation of this type of equipment.*

It is believed that this unit presents an exc balance between the weight, size, and power sumption of the equipment itself and the result tained. In the 500-watt system the equipmen be made portable (two 100-pound units), requir special mounts, brackets, or openings in the plane be quickly jettisoned in an emergency, and its p requirements are within the limitations of the pı class VPB planes operated by the Coast Guard. of the two units of the equipment would consist speaker and mounting yoke; the second would b complete amplifier with a compartment for cc box, microphone and cables.

SHARK REPELLENT, developed during th to prevent sharks from attacking flyers forced over water, has been converted along with othe materials to a peacetime use. Recently just o Gloucester the owner of the fishing boat *Angi Florence* surrounded his mackeral nets by shark lent in an attempt to prevent sharks from rippir nets and destroying the fish. His catch of 5 pounds of mackeral in comparison to his neig catches of 5,000 to 25,000 pounds proved the of his experiment.

WOLF CALL

Maybe there is some basis for calling ships after all. One Navy pilot owes his life to th that a U. S. Destroyer stopped to look around who whistled. Shot down in the Battle of Leyte the pilot spent the day dodging strafing attac leaving his life jacket on the surface and diving water. To keep warm, and to keep his head water, he swam about intermittently during the Three hours after sunrise the weary pilot, reali passing destroyer had not seen him, blew fı blasts on his own whistle. The destroyer tı picked up the water-logged pilot and later dep him, none the worse for wear, aboard his own ca



-up of keying cam.

airborne
OMATIC transmitter

t of the Coast Guard's Washington Radio Sta-
on Laboratory at Alexandria, Virginia, comes
airborne automatic transmitter designed to
e the locating of aircraft in distress via the
' network. Developed under Coast Guard
ship on the theory that any improvement in
of safety lessens the need for rescue, this new
tter is intended to close the gap caused by
me reduction of the number of IFF Radar
g posts.

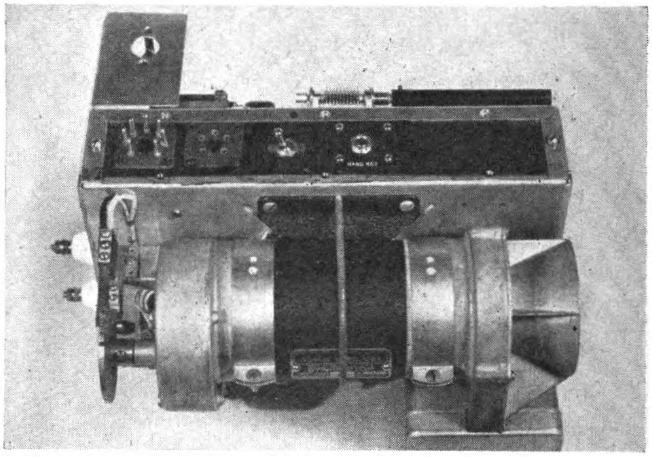
vn as the Model RL–226–A, and designed to
t distress signals on the 8280 kcs. band, ex-
ıtal models are presently in process of test and
ent in order to achieve the greatest degree of
ıbility for field use.

n the project was initiated early in 1945,
well-defined specifications were set up which
not only meet the rigid requirements of per-
ce, size, and weight, but would also standardize
edite the production procurement process.

st requirement was a compactness and light
ical construction comparable to the present
or smaller. It is believed an answer to this
nent is provided by the latest experimental
of the RL–226–A, which weighs but 31 pounds complete, and with redesigning is expected to weigh but 24.

Slow heating has been eliminated and instantaneous response provided in this new transmitter. It operates on the fixed communication antenna of the aircraft, has an output of 10 to 15 watts, and is powered from the aircraft's 24-volt battery.

A single switch automatically starts the transmitter, connects the antenna and performs all of the other functions necessary to signal transmission. While test models were designed to transmit the AB signal, production models, of course, will be set up to transmit $\overline{\text{SOS}}$.



■ *Bottom view of assembly showing how keying cam is attached to motor generator.*

Signal emission is provided by a code wheel which transmits an automatically repeated sequence of a five-letter call sign, followed by $\overline{\text{SOS}}$ and a twenty-second dash.

A second code wheel for limited emergencies, other than actual distress situations, with the same sequences as above except for substitution of a predetermined emergency signal in lieu of $\overline{\text{SOS}}$, is also provided.

The RL–226–A contains three Type 6V6–GT/G vacuum tubes—one functioning in a Pierce type oscillator, another serving as a buffer-doubler, and the third employed as a neutralized Class C amplifier. Plate and screen power are obtained from an ABK–3 motor generator.

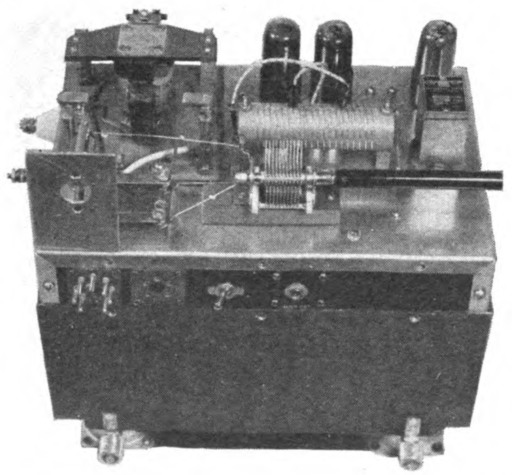
Constant input voltage (18 volts) is maintained by a carbon pile voltage regulator for the motor generator and vacuum tube heaters over a battery voltage range of 19 to 26 volts.

Keying is accomplished by interrupting the plate and screen voltage of the final amplifier. Automatic key-

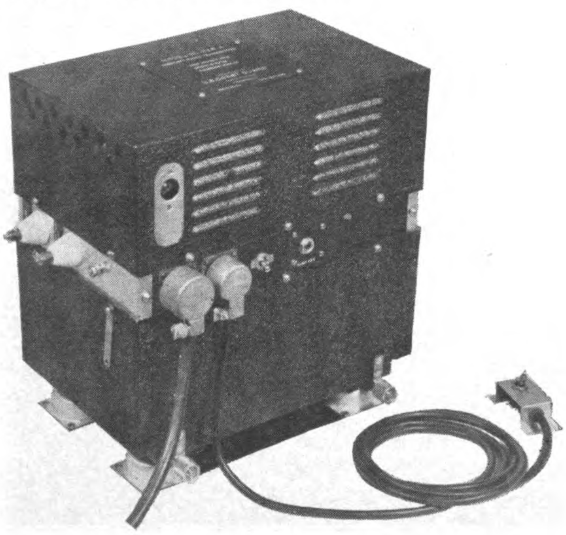
ing is provided by a keying cam driven by the motor generator. Jacks are provided to allow the metering of the buffer-doubler and amplifier cathode currents, and to allow the use of a hand key. In addition to spare parts and instruction material, major components of the RL—226—A are:

1. One radio transmitting unit complete with detachable shock mounting.
2. One pilot's control box.
3. One millimeter of suitable range complete with six foot cord and plug.
4. One telegraph key with shorting switch complete with six foot cord and plug.
5. Two complete sets of vacuum tubes and lamps.
6. Two Coast Guard type T–2 (25° C.) quartz crystal plates mounted in sealed holders.

■ *Top view of the RL–226–A transmitter with cover removed.*



■ *Complete assembly showing cords.*



SUGGESTED MODIFICATION O
H. O. 235

It is probable that Hydrographic Office Pul tion No. 235 (Methods for Locating Survivors A at Sea on Rubber Rafts) will be revised in the future to include additional information and ex ence on the subject.

With the idea that it may be of value to acti using the manual as an aid to search procedures suggested change is reproduced herewith. Comı on this suggestion, as well as on other phases of I 235 are in order in view of its projected revision. ments should be forwarded to the Air Sea R Agency, which will make them available to cogr officers of the Navy Department.

The change suggested herein was prepare Captain Fenner Chace, AC–AUS, of the Oc graphic Unit of the Hydrographic Office. To this change, it is necessary to strike out paragra and 4, page 5, of H. O. 235 and substitut following:

(a) Draw a vector representing the average rent shown on the Survival Chart (H. O. 235, p paragraph 1).

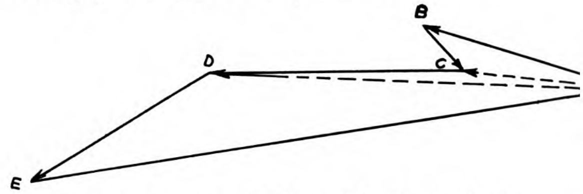
(b) From the end of the vector drawn in (a off a vector of magnitude of the average winc rent in the *opposite direction* from that calcı with the aid of H. O. 235, Table 2.

(c) From the end of the vector drawn in (b) a vector corresponding to the local wind current direction calculated with the aid of H. O. 235, Ta

(d) From the end of the vector drawn in (c), a vector representing the leeway of the raft (I 235, Plate II) in a downwind direction.

(e) The vector connecting the original and points of the diagram represents the directior amount of drift.

3. The revised procedure, as applied to Exa 1 on page 7 of H. O. 235, is as follows:



AB—Average current (273° at 10 mi. per day).
BC—reciprocal of average wind current (130° at 2 n day).
AC—average general oceanic circulation.
CD—local wind current (255° at 11 mi. per day).
AD—local current.
DE—leeway (225° at 9 mi. per day).
AE—probable drift (250° at 27 mi. per day).

'andma can't swim!

ıotion picture comes to search-and-rescue. When he Sailor lashed himself to the legs of the huge Roc ! formidable feathered bird lifted him out of the f Precious Stones, it may have been one of the first ulous thousand-and-one cases of search-and-rescue. rescue, as in most of those since, one important ele- ust always be present—complete understanding of s to be done by all parties concerned. Rescue is easy, often very difficult, and sometimes almost le.

IN THE SKY

in the hard, bitter realism of the Battle for over the English Channel, the network of and-Rescue has been spread over most of the For men still "go up and down the land, ınd over the sea," and something may happen one of them which will require search and operations. An Australian merchant crew, ning ship off the coast of Brazil, or an Ameri- ot and crew ditching a plane off the coast of present one common problem—an understand- escue, and of search and rescue. The over-all of rescue is not the whimsy of "pie in the sky." ; result of a vast amount of research, planning, ;, training, and accomplishment. And that only beginning, based on experience gained wartime rescues.

scue situation is an emergency, but it requires ıan emergency measures.

ime security requirements have necessarily con- ıuch information concerning search and rescue military services. Now that is past, and the worldwide network should be integrated with me facilities, such as state police forces, forestry , private and commercial ship lines and air nd other means of transportation. It has be- veryone's business all over the world. A fisher- sea, a businessman aboard his private or com- plane, a farmer or trapper in snow-covered an wilds may require rescue. In order to n under any and all circumstances, in any and es, with diverse nationalities and government, ; one prime requirement—standardization of ent, methods, and understanding.

lardization of equipment and methods of use, lanes and droppable lifeboats to survivor sig- devices, radio emergency calls and equipment, patterns calculated to save time as well as lives come vitally necessary. This interchange of ı, testing, experience, can be effected quickly and intelligently through the transmission of informa- tion and instruction. And the best medium through which to transmit is the motion picture.

CINEMATICS

Until the motion picture was invented, no means existed with which to bridge the void between languages. Gutenberg had dispensed information widely with his invention of the printing press, but the thoughts held on the printed page could be understood only if the reader was familiar with the language used there. Thus the barrier of language remained.

The motion picture tore it down, destroyed it. The Chinese peasant, watching a motion picture from America, with or without a sound track in his language, could understand not only *how* to build an airfield but also *why* it was necessary to build it in a hurry.

For every person who had been in or had seen an airplane prior to World War II, three persons had

seen and understood motion pictures. Today the figure is much higher, for the motion picture has been carried to the ends of the earth.

Motion pictures are man's imagination come to life, a vicarious realization of his inarticulate thoughts and emotions. As such, they are the most powerful instrument for education ever invented.

However, the men who first realized the possibilities in motion pictures were satisfied to confine them to the amusement world where quick financial returns were possible. Education was by-passed, except for a few rather feeble attempts to introduce them into the educational system. Millions of people attended the theatres seeking only amusement.

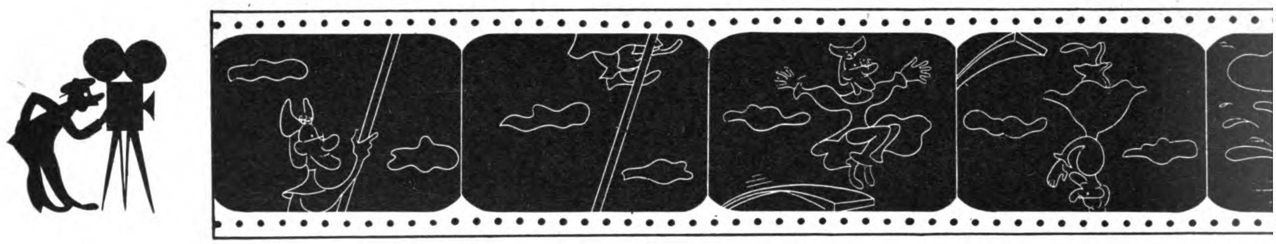
Education was taking place, by the very nature of the medium, for audiences were *seeing* what they had only heard about, read or imagined before. Such a powerful medium of idea-conveyance was bound to do much to govern the whole design of American and world living.

while the printed word remains *abstract.*

Time is a vital factor in this standardization. cue goes on continuously on land, sea, and in t Lives are being lost every day because standard and rescue information has not been sufficient tributed or has not been properly and adec presented. A survivor, equipped with everythin can devise to protect him until rescue, must kn right way to use it. The crew of a plane or must know standard operation of searching equi and its relation to the entire search and rescue o ation if the survivor is to be located. Any n used to inform and instruct all hands should swiftest available, with the smallest percent possible error in understanding.

PROJECTED

A considerable number of motion pictures fo tary purposes have been made and used in sear rescue training. They were built to specificatio



It was not until World War II that the necessity for swift and efficient education diverted the motion picture to its true use. The armed forces found in it that shortcut to knowledge that man had always sought. It has been possible to train a gun crew in firecontrol, under an efficient instructor, in a matter of months. Now, with the motion picture, it became possible to train a hundred or a thousand such gun crews, still under an efficient instructor, in a matter of weeks. And the result was *standard* instruction, so that crews might be shifted, fitted into new units, sent to new locales anywhere in the world.

There are a number of reasons why the motion picture is an almost perfect medium toward standardization. Through its visualization it becomes action. A gesture, a facial expression, a panorama of sea and sky *interpret.* Words in pamphlets, articles, manuals, reports, only *record.* Interpretation for them must come from the reader and offers wide variance from that desired. Equipment, methods of use, the right way and the wrong way, the good technique and the bad, when placed in a motion picture become *specific,*

did an excellent job. Some of them have nov by-passed by progress, the equipment shown in replaced, the techniques further examined and re for better ones, and the concept of search and enlarged. New and more detailed methods hav devised, and new equipment placed in use, req instruction.

With due regard for the value of such picture do not meet present-day specifications. Armec bat has disappeared as an element to be consi but a new element has arrived—that of the civilia will move by land, sea, or air from where h where he wishes to be. He is fortunate, for nc will he have all of the protection given the forces, he will also have working for him adapt of wartime equipment. For instance, the adap of the military Expendable Radio Sonobuoy to and rescue is already in progress. A photograp port is being made on its use. Training films made to teach survivors how and when to use i search and rescue planes and ships how to co their equipment to it.

R CREATES

r the stress of wartime conditions when thou-f motion pictures had to be made, it was y that black-and-white suffice. Color takes a re time, a little more care in photography and ng. The result, however, is always worth while is in color. This particularly applies to search cue.

ment used in search and rescue is often manu-l in color to give increased visibility. Smoke d signal lights, parachutes, lifevests and rafts, ation suits, all give more dependable results sing color. For this reason, it is important y be represented correctly by shooting them in

r factors are concerned when photographed in colors. A blue sky or a blue ocean is much rifying in color than in black and white. wells and surface waves have a more definite , important to search planes, when photo-l in color. Distance can be more precisely d because of contrasting shades.

ence reaction is important. Whether the film mative or for training, such reaction is more when color is used, for the eyes see normally r and must translate black and white if it is l. Less distraction occurs for this reason, and d is free to concentrate on the content of the . Less eye-fatigue occurs, also, and the e does not drowse off.

industry and the public have become color-is. One of the large airlines has recently an-l plans for screening pictures *in color* aboard s on over-sea hops.

IDMA CAN'T SWIM

military establishments will always require a work of search and rescue operations for the s of the world, it is in the new field of com-aviation and ship travel that the service must rated. Abandoning a ship at sea or ditching filled with civilian passengers of all ages and es requires a maximum of safety factors. And kbottom, hardboiled, minimum of all mini-1 safety requires that information and training the passengers as well as the crew on what to come a successful survivor.

ssume that accidents will no longer occur is ie that Grandma can swim. The best answer roblems of search and rescue lie in the word *on.* But the elements cannot be controlled, and if they act up enough someone will have to order a ship abandoned or a plane ditched. That will pose a problem demanding the right answer.

Suppose you, as head of public relations for some commercial airline flying scheduled oversea hops, found that public safety required the indoctrination of passengers as well as crew in safety and rescue operations. Your passengers cannot be hand-picked for age, physical condition, intelligence. You take them as they come, as they buy their tickets. Grandma, who never has been aboard a plane in her life, decides to buy one of your tickets to visit Paris.

Immediately it becomes your responsibility to explain to Grandma, a slightly unusual character, perhaps, but a passenger-to-be on one of your planes, just what happens and what she must do if the plane ditches out there in the Atlantic. And you have to do it without scaring the daylight out of Grandma.

You aren't going to interest her much by handing her a neat little pamphlet when she buys her ticket, expecting her to concentrate on the illustrations showing how to wear a life-jacket and climb aboard a liferaft. Probably you'll get the ticket and the *pamphlet* back in the first mail. Grandma has had time to change her mind.

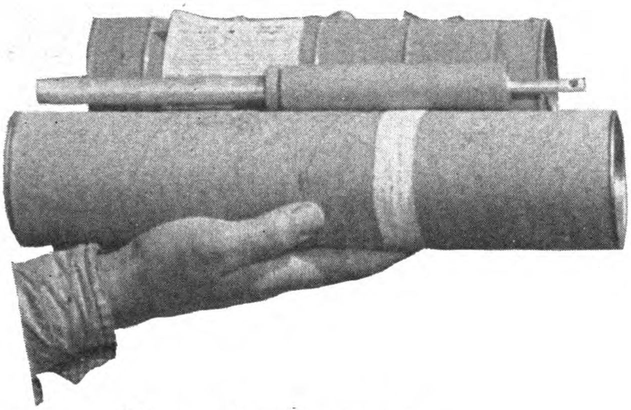
Handing her the pamphlet as she boards the plane won't help much, either. As for a ten-minute briefing before she boards the plane—well, you know she's in a dither, even if she doesn't.

Grandma still remains your responsibility, as do the other passengers. If she and they have to hit the water, there should be a visual picture in their minds of what the circumstances may be and *what they are to do about it.* A motion picture could present that, and it should be screened for them *after* the plane takes off for they are then a part of an existing situation. It can't happen to them, of course, but just in case it does. . . .

Search and rescue demands experimentation, study, training with the newest equipment, the latest methods. In its very nature it must be progressive.

It is the motion picture that can match strides with it, record it, and present its accomplishments.

The Army-Navy-CCA Manual of Standards for the control of instrument flight rule traffic—Section IV of which was published in the November, 1945 issue of the Bulletin—has received the approval of Army Air Forces, Navy, Coast Guard, and the Civil Aeronautics Authority. The Manual is now being printed and will receive standard distribution as soon as available.



▸▸▸ kytoons

Fickle wind . . . the meteorologist knows the reasons—the sailor knows the consequences. He has seen the wind in strata so that topsails were full and drawing, while mainsails flapped aimlessly. He has seen winds so strong that he has had to shorten sail only to find himself becalmed a few moments later. He has seen winds come in gusts and swing through eight points of the compass all within a few minutes. He has seen gales and calms within an hour or so of each other. This is wind—whose vagaries the Kytoon claims to master.

Emergency radio antennas, meteorological equipment, cameras and instruments of all sorts must, for various military and scientific purposes, be carried into the air. Formerly, a kite has been used in strong winds, a balloon in light winds. When the wind is strong one moment, light the next, neither kite nor balloon is satisfactory but, according to its manufacturer, the Kytoon is, as its name implies, a combination kite and balloon which goes up and stays up, let the wind do what it may.

This kite-balloon comes completely encased in a 14 inch package and can be inflated either with tanked hydrogen or with helium or with hydrogen generator M–315 (U. S. Signal Corps number). Instructions call for slow inflation (a period of about five minutes) and quick rushes of gas should be avoided. The elasticity of the nylon casing combined with the volume increase allowed by the flexing wing struts should aid the Kytoon in resisting large temperature or altitude changes. If gas is unavailable for re-inflating the Kytoon, air may be used. In a liferaft, this can be done very simply by means of the inflating nozzle furnished with the Kytoon which screws onto the liferaft pump.

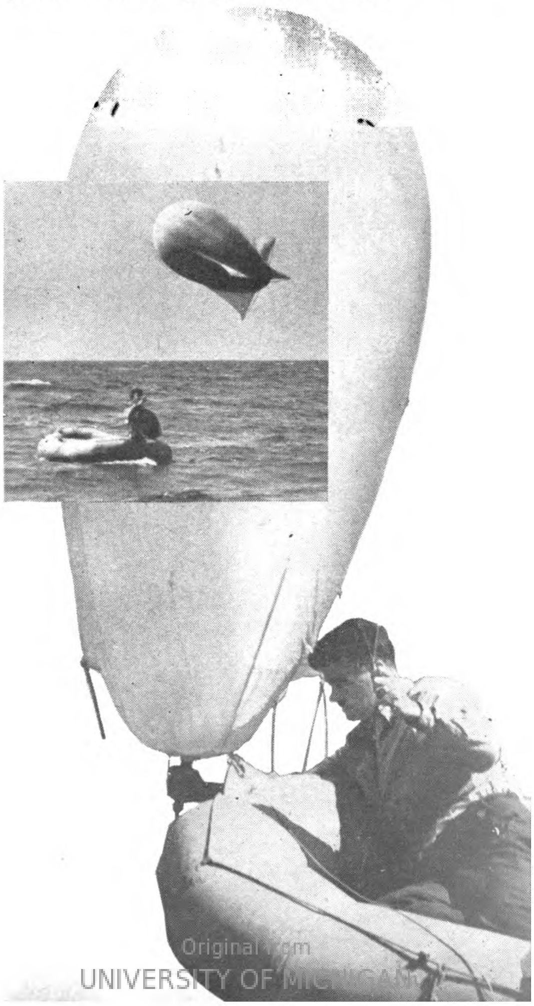
Test data furnished by the manufacturer show that the length of time the Kytoon will function as a balloon is controlled by the rate of diffusion of hydrogen through the film of its balloon bladder. If this diffusion rate is 5 grams per hour, the Kytoon wil[l] tinue to function as a balloon and be capable o[f] ing the flying cord in still air for a period of 72 h[ours]. These figures assume absolutely still air and in [prac]tice, it is claimed, the Kytoon has a conside[rably] longer life than 72 hours.

The question naturally arises as to what happe[ns to] the Kytoon in the rain. Unofficial tests by the m[anu]facturer show that although the free lift is appre[ciably] reduced by rain, it restores itself very quickly a[nd if] there is any wind at all, that wind will more [than] compensate for the loss in free lift caused by the [wett]ing of the fabric casing.

These same tests show a pull on the flying line is less than that exerted by either a kite or a ba[lloon] of equal lifting force at the same wind velocities [and] that the Kytoon is also extremely flexible and w[ill fly] at an excellent angle even when its free lift is negli[gible].

When the Kytoon flies as a kite, it has the adva[ntage] of being self-launching. Even if it has only en[ough] free lift to get 25 feet of line into the air, it is th[at 25] feet that counts and cannot be obtained when a [con]ventional kite is launched from a limited space.

Kytoon being inflated by means of a Signal Corps gen[erator] M315. Insert shows balloon attached to the flying lin[e by] "flying bridle" made up of cords as shown.



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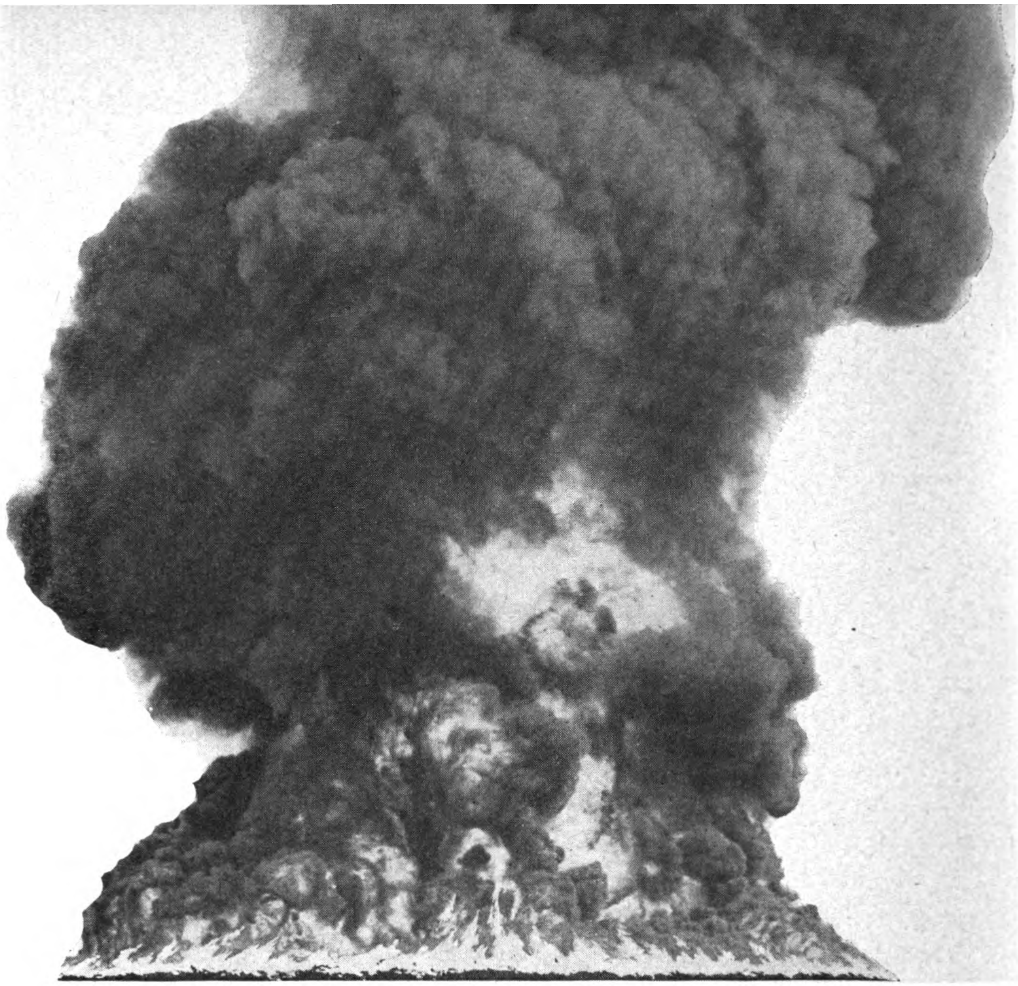


▶ WHAT FIRE IS. Fire is a chemical re- known as combustion. In order that combus- ay take place, three things are necessary, fuel, , and heat. The heat necessary for most fires rom an external source, although in some cases be self-induced by spontaneous ignition.

e may be represented as consisting of a triangle ed of the three necessary elements, fuel, oxygen, at.

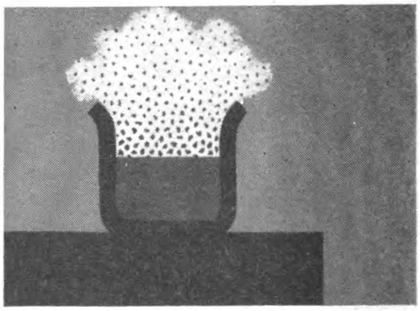
triangle will cease to exist if any one of its three removed. A fire will cease to exist if any one hree component parts is removed. Heat may inated by cooling; oxygen may be eliminated by ng air; fuel may be eliminated by removing it. ash fire fighting, all three of these methods are ngly or in combination.

elimination of fuel is sometimes easily accom- when the fuel consists of a vapor. Volatile may be the sources of such vapors and removal liquids removes the continual source of gases ors from them at the point of origin. Fuel directly removed from the fire or the object exposed to action of the fire may be removed from the fuel-saturated area.

HEAT

Reduction of temperature or cooling can be accomplished by the application of a substance which absorbs heat. Water is most commonly used for this purpose. It absorbs heat, first, in being raised to its boiling point and, second, in being turned from boiling water into steam. The heat thus absorbed is taken from the fire and reduces its temperature accordingly. Another substance used for this purpose is carbon dioxide gas which absorbs heat when its pressure is lowered from about 1,000 pounds per square inch to atmospheric pressure during its release from cylinders.

Gasoline vaporizes constantly at all ordinary temperatures.

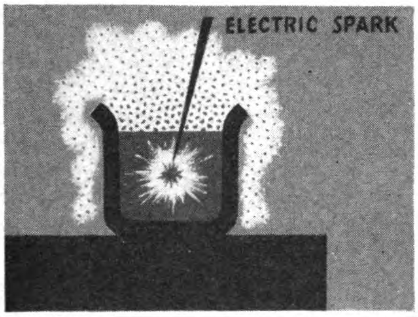


OXYGEN

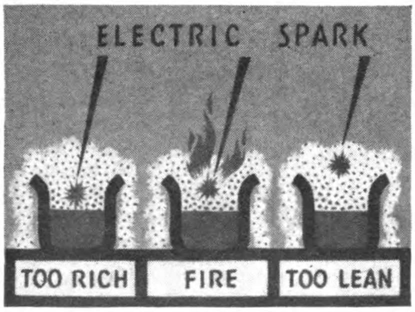
The exclusion of oxygen from a fire may be accomplished by covering the fire—as with dirt, foam, or a wet blanket—so that the air can not reach it. Oxygen may also be eliminated by surrounding the fire with another gas, which if heavier than air, displaces it from the seat of the fire. Examples of this are the use of carbon dioxide gas and carbon tetrachloride. The application of these extinguishing agents excludes air from the fire and in doing so removes the oxygen necessary for combustion.

GASOLINE AS A FIRE HAZARD

Success or disaster in crash fire fighting may be directly attributable to a fire fighter's knowledge, or ignorance of the basic characteristics of gasoline. Study of its properties is essential to skillful operations in crash fire fighting.



Gasoline liquid will not burn as long as it remains a liquid.



Gasoline vapor + air burns if not too lean nor too rich a mixture.

Contrary to prevalent popular opinion, aviation grades of high octane gasoline with ratings of about 100, do not present greater fire hazards than those of automotive grades, with a rating of about 73. Actually, automotive grades have a slightly higher volatility, and are therefore more dangerous; but for practical considerations, gasolines of any octane rating within the automotive or aviation range (from about 70 to 100) present identical fire suppression problems.

PRINCIPLES OF EXTINGUISHMENT OF GASOLINE FIRES

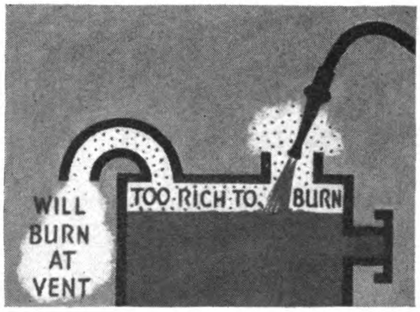
Under certain conditions all three methods of extinguishment of fire, or any combination thereof, may be used in combating gasoline fires. For examp confined areas CO_2 gas may be used to displac gen. Fog may be used to reduce temperature. source of gasoline vapors may be eliminated by ing fuel supply valves or by physically blowing gasoline by high pressure water blast. Gen speaking, any one of the methods, if properly exe may be effective. But under specific circumst considering the form of the hazard, external tions, and equipment available, some one or m these methods of attack will be found most pra

BURNING OR EXPLOSIVE LIMITS

Gasoline is a liquid which is constantly evapor liberating gasoline vapors at all ordinary tempera These vapors increase in volume as the tempe rises.

When a small quantity of gasoline vapor (be 1 and 6 per cent by volume) is mixed with a quantity of air (99 to 94 per cent by volume result is a combustible mixture which will bu explode if ignited. If a smaller quantity of ga vapor (less than 1 per cent by volume), or a quantity (over 6 per cent by volume) is mixed respectively larger or smaller volume of air, t sulting mixture will be respectively too "lean" "rich" to either burn or explode if ignited.

A spark set off beneath the surface of liquid



Filling t rich va forced o vent by

line will not ignite it. To demonstrate these fa a laboratory, a glass cylinder half full of gasolin be set up so that an igniting device such as a plug may be seen through the transparent When a submerged spark plug is sparked continu it will produce no effect. If this device is raise wards until the sparking point is just clear liquid, there is no action because the vapor-air ture just above the surface is too rich in gasoline If it is raised farther, a short distance abov surface a point is reached where the vapor-air m is within the flammable limits (1 to 6 per cent ga vapor by volume). At this point ignition of the line takes place. If the flame is then extinguishe

ting device held at greater distance above the
t which original ignition occurred, there will
e no ignition. The mixture has been diluted
arge volume of air surrounding the spark plug,
it is too lean in gasoline vapor to support
tion.

INE TANK HAZARDS

practical effect of this property of gasoline is
er full or nearly full gasoline tanks safe from
since the liquid itself will not burn, while the
ace immediately above the liquid is so rich in
vapors that ignition will not occur.

ie gasoline tank is emptied, the vent opening
outside air to be drawn into the tank to occupy
ce left by the outflowing gasoline. Sufficient
now be drawn into the tank to form a com-
mixture with the gasoline vapors normally
by evaporation from the liquid surface. A
this condition is a potential hazard.

e tank is not emptied but remains partially
dditional gasoline vapors constantly given off
gasoline will accumulate, displacing the leaner
ir mixture and forcing it out as a gas through
t pipe, meanwhile enriching the vapor-air mix-
thin the tank. Finally the point is reached at
the mixture is too rich to support combustion.
is then no hazard within the tank unless addi-
air is admitted. During the enrichment of
xture by normal evaporation within the tank,
stible mixtures of gasoline vapor and air may be
ged through the vent. This same condition
if the tank is filled with gasoline. The inrush-
uid displaces the rich vapor in the tank and
t out of the vent. This mixture may be haz-
If ignited at or beyond the vent opening, it
rn, firing back to the vent opening. Under the
stances described, the flame will not ordinarily
back within the vent tube into the tank, and
ishment is simple at the vent opening.

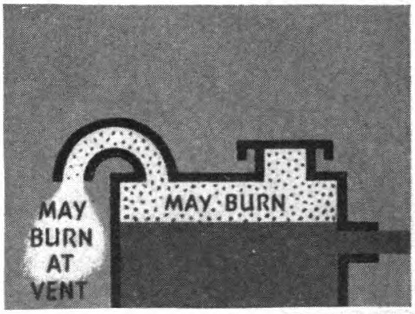
nditions are reversed and gasoline is withdrawn
he tank with combustible gasoline vapor-air
existing outside, in the vent, and within the
tion of the tank itself, any ignition occuring
may follow through the vent tube and into the
The influx of vapor-air mixture thins out the
sly too-rich mixture to a combustible point as
oline liquid level is lowered.

arly empty or presumably empty gasoline tank
nts a great hazard because very small quantities
line liquid vaporize completely and in a short
e entire volume of the tank is filled with a
uniform mixture of gasoline vapor and air. If the mixture is within the combustible limits, as is frequently the case in nearly empty tanks, it may provide conditions ideal for an explosion. *Small quantities of gasoline in nearly empty tanks may be far more hazardous than many gallons in properly vented tanks.*

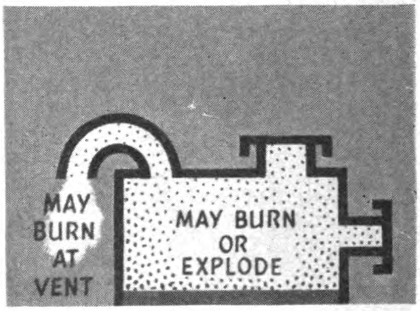
GASOLINE EXPLOSIONS

An explosion is simply an extremely rapid burning. Gasoline vapor-air mixtures burn by spread of the flame to unburned portions of the mixtures. Near the upper "rich" and the lower or "lean" limits of combustible mixtures the flame spreads at relatively low speed. Above or below these limits, the flames is not transmitted at all; i. e., the mixture will not burn.

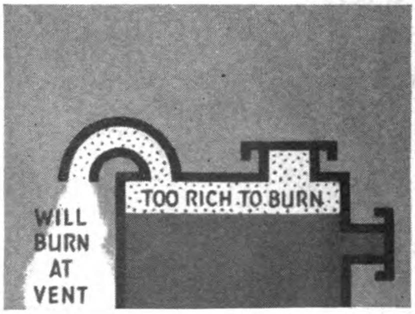
Emptying tanks air drawn in thru vent rich vapors made leaner.



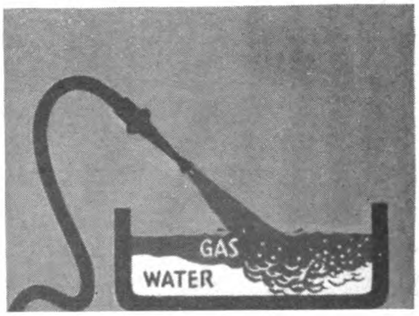
Empty or near empty tanks large space for vapor-air mixture.

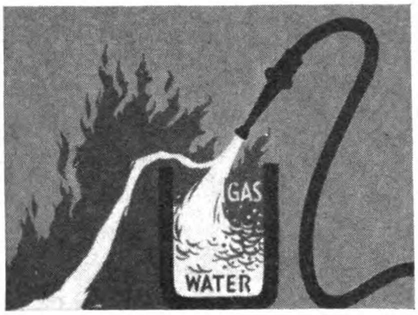


Standing tanks vapors flow from vent slowly.



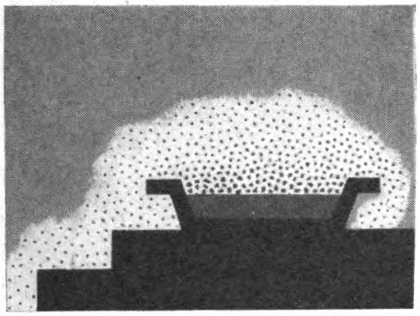
Gasoline floats on water when mixed will rise.



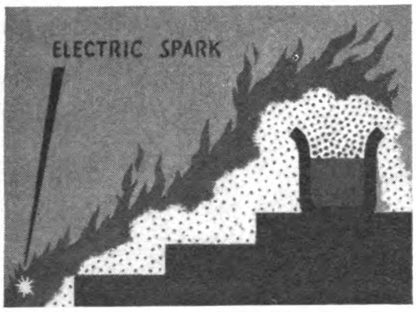


Gasoline flooded from a tank by water increases the hazard.

Between the extreme limits which will support combustion, there is a proportion which most rapidly transmits the flame throughout the mixture. When the mixture is near this proportion and other conditions are favorable, a flame is carried throughout the mix-



Gasoline vapor flows is heavy—sinks in air and follows ground or floor.



Gasoline vapor will back flash to source if ignited.

ture almost instantaneously. If there is much mixture present in this proportion, there is a tremendous production and expansion of heated gases. The violent force of this expansion, if restrained by walls or a container, ruptures its confining walls. This is an explosion. *The more thoroughly gasoline vapor and air are mixed and the more they are confined in pockets or containers the more dangerous they are if ignited.*

IGNITION OF GASOLINE

The ignition temperature at which a flammable mixture of gasoline vapor and air will ignite, is relatively low (about 500° F.) and this fact, coupled with the constant evaporation of gasoline at ordinary temperatures and low proportion of vapor mixture for combustion are the features which render this fuel so hazardous. *A spark or exposed flame is not necessary for ignition of gasoline.*

If through any internal or external source of the temperature of a gasoline vapor-air mixture w the flammable limits is raised to its ignition tem ture, burning or explosion will ensue.

Heat released by the burning or vaporized gas and air is intense. Heavier oils may have greater producing properties but are much more diffic ignite than gasoline. When a heavier lubricatir is combined with gasoline, as frequently occurs i plane fires, the gasoline serves to provide ignition raises the temperature of the oil to ignition p The resulting fire of the combined substances pro a source of extreme heat, making effective cl fire-fighting operations difficult.

GASOLINE FLOATS ON WATER

Gasoline liquid is lighter than water (about t fourths of the weight of a similar volume of wa Consequently it will float on the surface of w This property is dangerous when combating gas fires with some water streams. Heavy streams or quantities of water, when applied to gasoline may spread the gasoline over larger areas. The line then comes to the surface and floats upo water, often reigniting over a much larger area originally existed. Gasoline fires spread in this ner may involve adjacent combustibles.

FLOODING GASOLINE TANKS

Water flooded into containers of gasoline may the level of the burning gasoline, which remains stantly floating upon the rising water surface, tually spilling and spreading the fire. On the hand, this property of gasoline may be usefull plied to certain types of fires. When the bottom gasoline tank is leaking and on fire, water m flooded into the tank to displace the gasoline up When sufficient water has sunk to the bottom to the point of leakage from the tank, water inste gasoline will flow from the leak and the source c to the fire will be cut off.

BACKFLASHES

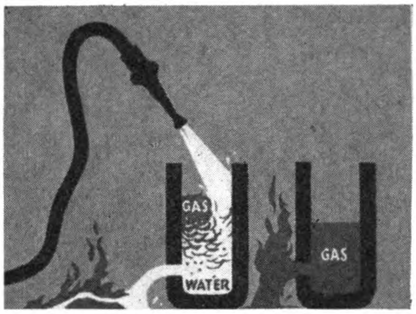
If a gasoline fire is extinguished, leaving unb gasoline present, vapors will rise from the grou liquid will float exposed upon the surface o ponded water which remains from the fire-fi operations. This surface gasoline is readily i from any open flame or from heated objects although not actually burning themselves, may s hot enough to ignite gasoline. Reignitions c kind are termed "backflashes" and are characte

dangerous in gasoline fire fighting. The back-
may occur during progress of a fire behind fire
in areas in which extinguishment was thought
›mplete, or they may occur at any point follow-
ıplete extinguishment of an entire area.

MUST BE FLOATED UPON GASOLINE

e gasoline will float upon the surface of water,
mployed for fire fighting will, if properly ap-
loat upon the surface of gasoline. It is this
y of foam which renders it effective in blanket-
gasoline surface. It reduces or eliminates the

above
ks will
fires.



vaporization of the gasoline. At the same time
des oxygen from combustion taking place at the
. Foam is largely water. It must have suffi-
r or gas in the form of bubbles to render the
mass lighter than the gasoline so that it will
›on the gasoline surface. If too "wet" a foam
flotation is difficult because its weight tends
the foam below the gasoline surface. Care
e used to float foam gently upon the gasoline
. Excessive force of impact breaks up the
llowing the water within the mixture to sepa-
d sink to the bottom through the gasoline.

OF GASOLINE VAPORS

line vapor is heavier than air and consequently
lowly downward to ground level or any lower
It spreads out and follows the surface to low
flowing in the same manner as a liquid.
ılations of vapor will spread over a flat sur-
ow downstairs or drop through openings in
es or crevices in the ground. These vapors
ly mix with the air, but if not affected by drafts
ıy remain in low spots for a considerable time.
lk of the vapors in such low spots or flowing
ıe ground may be too rich to burn when first
l. However, there will always be on the outer
of the rich mixture a part of the vapor which
ed with sufficient air to be within the combus-
explosive gasoline vapor-air mixture limits.
on does not occur at this time the richer vapors
will slowly diffuse with the air until a flammable mixture exists over a considerably increased area. This increases the possibility of ignition resulting in burning or explosion. The larger the quantity of diffused mixture within the flammable limits, the larger the resultant fire or explosion will be if the mixture gets ignited.

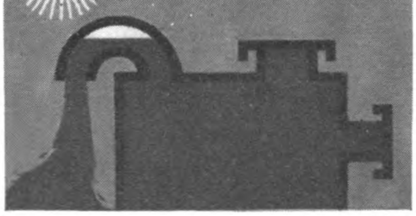
A flame has been reported to have traveled 162 feet along the path of gasoline vapors, returning to the source of gasoline and igniting it. For this reason spills or discharges from gasoline tanks or tank wagons must be regarded as potential hazards and steps taken to prevent their spread, accumulation in low areas, and ignition through accidental causes.

EXPANSION OF GASOLINE

Gasoline expands with temperature rise in the same manner as water. Its increase in volume is about 6 per cent for each 100° F. rise in temperature. If a tank is filled to the overflow point with cool gasoline, and the tank is placed in the sun, adjacent to a fire, or to any source of heat, expansion of the gasoline will occur. As the temperature rises, the volume of the gasoline expands and drives the surplus liquid out through the filler, overflow, or vent tubes. If for any reason vent or overflow tubes become clogged, excessive temperature rise, as by exposure to a nearby fire, may produce expansion of the liquid sufficient to rupture tanks. Such tank ruptures must not be confused with ruptures caused by the burning or the explosion of gasoline through ignition.

The rupture of a tank caused by the expansion of gasoline from heat may be followed by the burning or the explosion of the gasoline released. In this case it is the rupture which makes the fire or explosion possible rather than the fire or explosion being the cause of the rupture. *The danger of tank ruptures from the expansion of gasoline can be prevented by the simple cooling of the exterior tank surfaces with water. This will absorb heat and protect the gasoline from a great temperature rise.*

War Department TM 5–316



Gasoline expands when heated will escape from vents or fillers.

drinking water supply on the life raft

Edwin S. Fetcher, Jr., Ph.D. Personal Equipment Laboratory, Wright Field, Dayton, Ohio.

The supply of adequate amounts of drinking water for occupants of life rafts on the open sea has long been a problem in the AAF. Requirements originally were established as 1 pint per man per day, but recent investigations by the Office of Scientific Research and Development have shown this figure to be inadequate and have established the requirements to replace total fluid loss at various temperatures (table). These requirements are comparatively high estimates, being calculated on the basis of actual replacement of minimum water loss under life raft conditions. Activity, exposure to the sun, and vomiting are factors which would increase water loss. Reduction of perspiration may be achieved through inactivity, low caloric diet, the provision of shade, and the wearing of clothes wet with sea water during the time the sun is out.

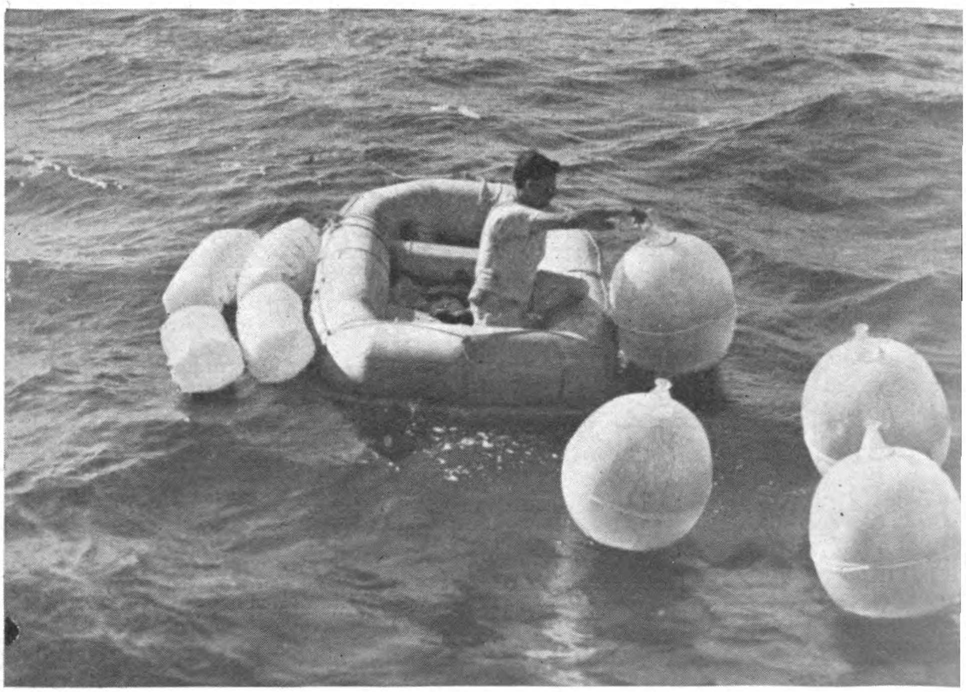
In attempting to furnish occupants of life rafts with more nearly adequate supplies of drinking water, the AAF has investigated two non-expendable sources, the rain catching life raft paulin and the solar still, and an expendable source, an apparatus for the chemical removal of salt from sea water.

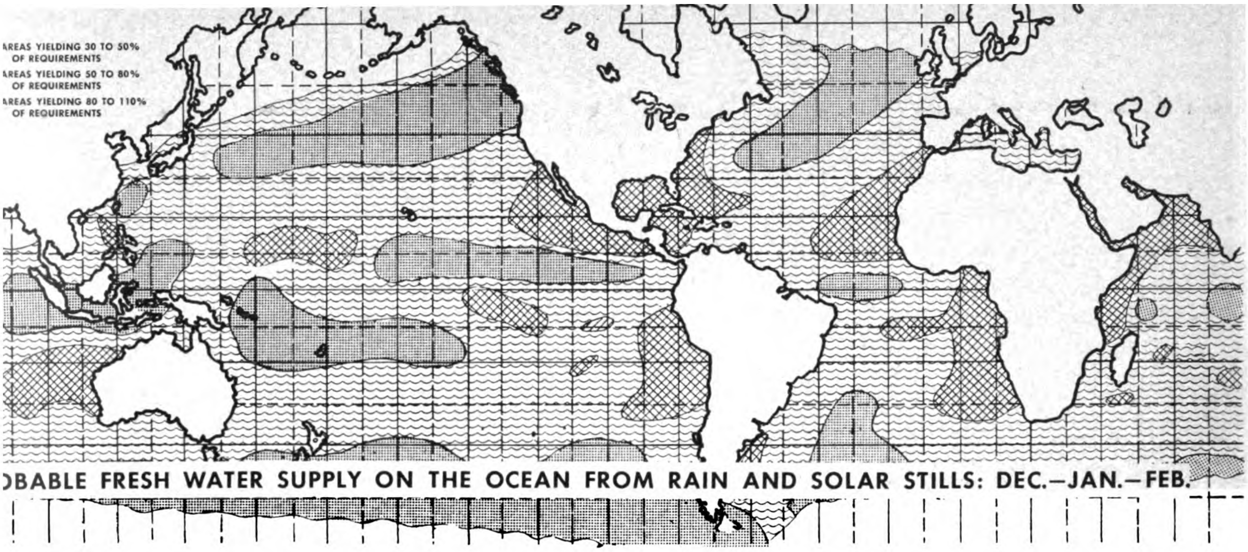
LIFE RAFT PAULIN

The standard AAF life raft paulin, with an area of 77 square feet, can be utilized to collect rain water. Equipment issued for water storage in connection with the paulin consists of 4 plastic bags with a total c ity of 5 gallons. The paulin is stretched o occupants of the raft in such a manner that the c at one end are closer together than those at the thereby permitting accumulated rain water t into the storage container. Placing a weight i bottom of the paulin aids in producing the desire nel arrangements.

The quantity of usable rainfall varies consid with the frequency of storms, the character c rainfall, the wind, the skill of the raft's occu and the rate of water consumption. The freq of rainfall, rather than the total rainfall, is imp as a limiting factor in the use of rain as a sou drinking water. Assuming a 50 percent collect the rainfall on a 77 square foot area, the 5 g storage capacity can be filled from individual s in areas of moderate rainfall frequency. Beca the limited storage capacity, the rains may grouped that not all the storms will be useful allow for loss due to this factor and to the variat rate of consumption, the amount of water might be collected if storms were properly distri is considered reduced by 25 to 50 per cent, depe on the temperature. Difference in percenta duction is based on the greater rate of water con tion at higher temperatures.

Charts were prepared showing the percent





)BABLE FRESH WATER SUPPLY ON THE OCEAN FROM RAIN AND SOLAR STILLS: DEC.—JAN.—FEB.

ıintenance water requirements to be antici-
n the oceans from the rain alone during 2
t seasons.* The charts are based on (1) the
:hing and storage equipment described above,
a given in Weather Division reports, and (3)
king water requirements outlined in the table.

STILL

irst solar still standardized by the AAF was
Water Distillation Kit, Type LL–1, AAF
ation No. 40897, which is now substandard.
e LL–2 Sea Water Kit, AAF Specification No.
s now standard. Both types consist of 3 stills
essories. Included in both is mending tape
iring cuts in the distilling bags. The weight
L–1 kit is approximately 3½ pounds, with a
nent of 160 cubic inches. The LL–2 kit
about 5 pounds and its packed bulk is ap-
tely 180 cubic inches. As with the LL–1
–2 kits are to be provided in multiplace rafts.
t contains a booklet giving complete details
:ration, and directions for use also are stamped
still. The removal of salt and purification of
ər is accomplished by distillation. The sun's
t the sea water, causing evaporation, and the
:d vapor runs into a reservoir.

LL–1 still consists of a closed, transparent,
ylinder 30 inches long and 13 inches in diam-
ıtaining a sheet of black sponges stretched
s diameter. In using the still, the sponges
rated with sea water, the plastic cylinder is
and excess sea water is drained. The stills are tied to the raft and allowed to float on the ocean with the sponges facing the sun. Water vapor evaporating from the sponges is condensed on the cylindrical envelope and collects in a reservoir. The salt residue is washed out of the sponges daily.

The LL–2 still consists of a transluscent plastic hollow sphere which can be inflated. Inside the sphere is stretched an essentially spherical black cloth upon which sea water drops from a reservoir. The sun heats the black cloth from which fresh water evaporates, condenses on the plastic sphere, and is collected in a trap. The LL–2 still requires no orientation while floating on the ocean, as does the LL–1 still, and is simpler to operate than the LL–1.

The yield of the solar still is dependent upon (1) the intensity and duration of sunlight, (2) the efficiency of the still in the conversion of solar energy in the distillation process, (3) the heat absorbing area of the still perpendicular to the rays of the sun, and (4) the human factors involved in the operation of the still. Tests conducted at Eglin Field to determine the efficiency of the LL–1 still revealed the sunrise to sunset efficiency to be 38 per cent under optimum solar conditions. The average yield per still under these optimum conditions was 800 cc. per day, or 4,800 cc. for 6 stills (2 type LL–1 kits). In these tests, the stills were operated most of the time by inexperienced personnel. The yield of the LL–2 is approximately 1½ times that of the LL–1.

The accompanying map shows the percentage of bare maintenance water requirements to be anticipated on the oceans during the months of December, January, and February, from rain and the yield of 2 type LL–1 distillation kits (6 solar stills). The yield of the stills is calculated from the solar intensity and duration data given in Weather Division reports and from the results of Proving Ground Com-

:harts and 2 others, showing percentage of requirements
cipated from both rain and solar stills during these
ıns, may be obtained by writing to the Service Liaison
:rsonal Equipment Laboratory, ATSC, Att: TSEAL–5D,
eld, Dayton, Ohio.

mand tests. The use of type LL–2 stills will eliminate almost all the area yielding 30 to 50 per cent of requirements, changing them to the 50 to 80 per cent range, and also will increase the area yielding 80 to 110 per cent of requirements. In general, use of LL–2 stills will raise the percentages in figure 3 by 15 to 20 per cent.

SEA WATER DESALTING KIT

Additional equipment for a supplementary supply in the event that the solar still does not provide sufficient water is available in the form of 6 Sea Water Desalting Kits, Type JJ–1, now standard equipment for multiplace rafts. The kit weights 22 ounces and its dimensions are 5 by 4 by 1¾ inches. Each of these kits contains 6 briquets of a precipitating agent, and a processing bag. The individual briquet weighs 2¾ ounces and measures 3½ by 1½ by ⅝ inches. Each kit can produce 5½ pints of drinking water. The purpose of the kits is to provide a source of drinking water independent of climatic conditions. This source should be used only if conditions are such that neither the stills nor the rain catching paulin can be used. Under these circumstances, the drinking water allowance should be reduced to not more than 1 pint per man per day.

The chemical principle involved in the desalting process is the reaction between the silver zeolite of the briquet and sodium chloride. Silver chloride and sodium zeolite, both insoluble, are the products of the reaction. Full directions for use are included with the kit. The processing bag is filled with sea water up to a marked line and the briquet dropped in. The bag is kept in motion for an hour, allowing the briquet to break up and interact with the salt of the sea water. Desalted water passes through a filter in the bottom of the bag, from which it may be consumed directly or squeezed into a storage bag.

COMMENT

An examination of the charts of water supply leads to the conclusion that in large and important areas of ocean, rain alone will provide little or no drinking water. It is obvious that the type LL–1 solar stills will constitute a great advance toward the solution of the problem of water supply on the oceans. It may be concluded that the LL–1 still provides 20 to 25 per cent of the bare maintenance water requirements. In terms of quantities, this means that, with what rain is available, it is probable that the water supply will nowhere be less than 5 pints of water per day per raft. In most areas the supply will be 8 to 16 per day (50 to 80 per cent of the requirements men). In many areas, as much as 80 to 11 cent of the required water should be available. use of type LL–2 stills will provide correspon larger quantities.

The conclusions are based, of necessity, on cli logic averages. The skill of the user, the aı and character of wind and rainfall, and unavo mixing, of rain with sea water due to splashin cause variations in the calculations.

It is the role of the sea water desalting kits to pensate for deviations and errors by providing plementary drinking water when the nonexper sources are inadequate. The kits can be used almost any conditions in which the survivor do need both hands to hold on to the raft. A fı safety factor lies in the improvisation of rain storage in excess of the 5-gallon capacity furn In spite of their inaccuracies, the charts are use a basis for prediction of the type and quant equipment which should be carried.

The ideal solution to the water supply pr would be the development of a nonexpendable of drinking water, yielding adequate water under tically all climatic conditions. An alternative tion would be a specialized nonexpendable which could be used under conditions of obscur and no rain to supplement solar stills and rain-ca facilities. No practical development of eithe

tion is in sight at present, nor will any great in in drinking water supply be practical, ordinaı increasing the size or number of type LL–1 or stills. This is due to severe limitation of av space and weight in most dinghies currently i and to the impracticability of using many mor 6 stills, or stills much larger than the LL–1 or on a life raft.

If an increased yield is to be obtained, it wil to be accomplished through the media of more e

ɪ an increase in effective heat absorbing area. a may be increased in effect by proper orien- f a flat surface or by the use of a spherical ɪg surface, such as that of the LL–2 still, which requires no orientation. If present estimates are approximately correct, such stills, yielding an adequate water supply under almost all conditions, may be considered a reasonable goal.

If solar stills in life rafts can be made to provide an adequate drinking water supply, water no longer will be the most common limiting factor in ocean survival. Much longer survival times may be anticipated as a consequence. This may have a profound influence on the requirements of the life raft and its survival accessories other than water. The essential items of this equipment should not, in turn, become limiting factors. In particular, the ration problem will require re-evaluation in the light of longer survival times. Such a re-evaluation should include not only studies of rations carried as accessories to the raft, but also of reliable and effective means of obtaining food from the environment and, perhaps, methods of curing or cooking it.

Air Surgeons Bulletin, October, 1945.

TABLE

ıter Intake Required To Balance Water Losses at Various Temperatures

: Temperature in de- 'ahrenheit	90	80	70	60	50	40
·quirements for Bare ·nance in pints per r man	6.2	4.0	3.3	3.0	2.8	2.7

ɔove intakes are predicated upon the survivor being inactive, upon his taking precautions to reduce s, and upon a low caloric intake. The elements of change of state of hydration of the survivor are liminated by the use of these values, which refer ·ntially steady state.

V DID IT START? ? ? ?

***HING* . . .** Unlike many search and res- ns that were coined or originated with the ment of the science of rescue, *Ditching* has in antiquity. Given in Webster's Interna-)ictionary as a colloquial expression meaning ıdon, to discard, to throw away. . . ." it was quite apt to be introduced into ward room ly room conversation. But the aptness of the ıd its many connotations kept it from remain- g and led to its adoption in formal technical about forced landings at sea.

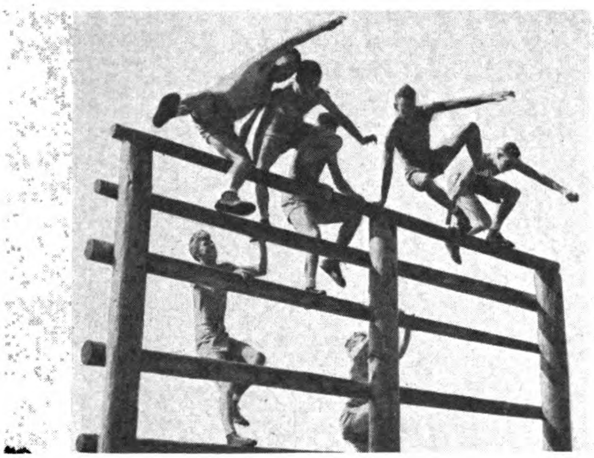
·xplanation was the association of early in- of ditching with the "Big Ditch" or English . As early as 1589, in recognized historical , the English Channel was referred to as the Ditch," but the term was not limited to that ɔdy of water. American writers in the early hundreds referred to the Atlantic Ocean as Ditch," to say nothing of the Panama Canal, Slot" in the Pacific. In 1876 a Pennsylvania *ʒ Calendar* established the word *Ditching* to aking refuge in a ditch to avoid being caught."

npossible to trace the present use of the word :he first person who used it, if there is any such al. The English language is a live, growing body of words, and *Ditching* is an excellent example of its modern evolutionary adaptation.

***MAYDAY* . . .** At the first international radio conference of radio and telegraph operators held in Washington, D. C., in 1927, the French phrase "M'aidez" was adopted as an international radio voice call to indicate distress at sea. The conference felt that French was more internationally understood, and the English speaking mariners adopted the standard code word *Mayday* which closely approximates the French pronunciation. This agreement was unanimously approved at each subsequent convention of radio operators, and is applied to both ships and aircraft.

***VIDEO* . . .** Unlike *Ditching,* which grew like Topsy, or *Mayday* which has been formally adopted by an international convention, the word *VIDEO* (VeeDayoh) is still unknown to many pilots, mariners, and search and rescue personnel. However, adopted officially by both CinCPOA and FEAF just before the end of the war, it bids fair to take its place as an international emergency radio call. Coming from Latin, meaning "I See," *Video* is to be used by ship or plane sighting an emergency, spotting survivors, or in response to a distress call when immediate action can be taken.

Training pays off



DURING the period when heavy bombardment of Japan was being carried out by B–29 crews, one of the best kept secrets of the war was the fact that crews were briefed to fly into Russian territory above Vladivostok if they were so damaged by anti-aircraft or fighter fire as to be unable to return to their own bases.

This is the story of one such B–29 crew, forced to bail out in the mountainous territory between Khabarvost and Kosmolsk in the fall of 1944. The entire crew was rescued and reunited 45 days after bailing out, and the story of their struggle to survive and reach civilization, and of the help received from both Soviet citizens and Soviet Air Force personnel, make it one of the most interesting survival narratives of the war.

Not only is this story significant because of the abundant evidence of the thorough training in survival received by the B–29 crews before their offensive operations, but also because of the efficiency of the Soviet Air Force in handling rescue operations.

The crew elected to bail out over Soviet territory when it was discovered that one engine of their B–29 had been shot away during their attack on the Jap Islands. After flying for several hours to make sure they would be well away from Japanese held Manchuria, the men bailed out at about 0400 near the headwaters of the Monoma River.

They were scattered during the jumps, and eventually formed into three main groups. The largest of these, made up of seven men, divided itself on the 11th day, and an advance party was sent down river for help. This party reached a small villag the 19th day, and a search was immediately initi by the Soviet Air Force. While waiting for v from the advance party, the first group was joine two other crew members, and all six were locate the 21st day by Russian pilots, rescued by grc crews and sent up the river. All nine men in group were hospitalized at Khabarvolsk.

The pilot, who jumped last, and evidently lar some distance from the others, was joined by a sergeant. These two may have followed an ent different stream. They were not located until 31st day, and were taken first to the hospital at K molsk. Forty-five days after bailing out the e crew was reunited at Khabarvolsk.

The report of the pilot records many of the l difficulties faced by all of the men in the crew:

"After making certain that no one was on the interp I made my way to the nose-wheel well, cut the master s and bailed out. Instead of striking the ground, my fouled in a tall evergreen. I waited several hours until light and then discovered that I was about sixty feet i air. It took me approximately six hours to reach the gr

"Once down, I took stock of the jungle kit in my chute pack. My equipment consisted of a machete (v is too light), compass, matches, fire starter, gloves, signal flares (railroad type and which should be encas water repellant material), first aid equipment, frying rations, signal mirror, feather filled two-tone blanket line, hooks (should be small sizes as well as large), sinkers a survival book.

"The only item missing from my kit was a bottle of quito repellent which Staff Sergeant Charles Robson with him when we met after an unsuccessful attempt to our plane two days later.

"Between us we had approximately six complete 'K tions and two parachute rations, and these were use sparingly during our trek. (As a matter of fact, we

ɔ open the last tin when food was dropped to us on h day, so we came out with one complete ration vas given to the Red Army Hospital at Kosmolsk for

With a strict ration policy we were able each day something to eat for breakfast or supper even though nly 1/8 of the normal ration.

plementary food was scarce. We were unable to kill or squirrel with our 45's so we made a porridge of te boiled frogs, snails, and mice. In fact we ate ving thing we could catch except spiders. Sugar ants elicacy.

; 'meat' was supplemented by a few fish which we ɔle to catch. Nothing was wasted and those parts ire generally thrown away we found to be most tasty.

quantities of shamrock which was most enjoyable nd for three days we lived entirely on a wild grape vas eaten stewed as well as fresh. The leaf and stem so very palatable. We generally grubbed as we went ɪicking berries, leaves, snails, frogs, etc., eating shamring periods of rest and munching a dextrose tablet noon meal.

veling in a virgin forest without trails (very few trails and no large game seen), over fallen timber, dense underbrush, wading swampland with either dry clothes is not easy going. Traveling several miles the day as well as working to get fire wood, and making r and a bed, the food that we finally got didn't go so we talked of the food at home—of roasts, puddings, soups, and desserts. We didn't get stuffed but it

tried to help our cause by building a raft, the timbers h sometimes required two hours of chopping to go , but after three days of work we traveled three 1 yards, rounded a bend and there was a log jam. vas considerable force in the impact of the raft against ; and we lost some of our gear, fortunately not our

son lost his left shoe, and after several attempts at ; a sandal he produced a moccasin from his .45 holster. vith this uneven footgear that he continued to walk on. ourse, the going was slower, but determination moved ıtil we reached a point where we had to stop to repair hing and try to catch fish and gain enough strength :l. Autumn was setting in—snails were no longer e and only a few frogs happened our way. Our vould depend upon a miracle.

as while making camp in the forest—too weak from ɔ reach the river—that we heard aircraft flying fairly to the east of us. We had heard and seen aircraft a period of about five days earlier in the month but re too high and out of range. We piled boughs on but our signal was not seen. However, in about half the planes returned and this time our smoke was seen. nes circled and buzzed, and flew away.

next day we moved on the river bank and along evening, after again being located by light bombers, visited by a light training plane which dropped us Russian food (two loaves of black bread, 2½ lbs. sugar, sweetened white flour, and a can of pork), matches, and a note in English telling us that we USSR. Incidentally, it was a pleasure to throw out of moss porridge which was cooking when our first bag of food was dropped. Two more bags were dropped the next day, but we recovered only one. With the food was a map and a note telling us to go to the village of Tolomo which was about nine or ten miles away.

"Two days later, having repaired our clothing, we started out but made very little progress—making an early camp along the opposite bank of the river. We had just made a fire when two training planes came along and after a bit of trouble located us, dropping expertly three bags of food and three notes which told us to stay where we were and await a ground party which was coming to our rescue.

"This was most welcome news as we were both too weak to do much more walking. (We had estimated that it would take us six days to reach the village unaided). These notes also contained the good news that the other members of the crew were OK. We suspected that some of them had gotten out and instituted the search.

"About noon of the following day we were approached by two natives and a Russian engineer named Poboshin poling a dugout up the river. Too much cannot be said about the skill and craftsmanship of these boatmen. Our lives were still in danger traveling down the river the next three days, under log jams, through white water that only men born in the wilds of nature could safely traverse.

"We were treated with the utmost kindness by the Russian engineering party that had made camp at Tolomo while looking for us, and the natives of the village itself during our twenty-four hour stay there. Down the Amor river, their first thoughts were of their two American companions, and this vigil did not relax until we were turned over to the doctors at the Red Army Hospital in Kosomolsk, USSR, just forty days after parachuting from our plane.

"Staff Sergeant Robson weighed 40 kilograms (a loss of 30 to 35 lbs.) and I weighed 61 kilograms, (a loss of about 25 lbs.).

"We remained under excellent care at Kosomolsk until the 44th day, arriving at Kharbarvosk on the 45th day—thus uniting the entire crew. [Though our treatment at the second hospital wasn't as thorough as at the first, the care enabled my crew to regain the better part of their strength during the remainder of the month."]

The invidual narratives of the nine other crew members showed they encountered much the same difficulties as the pilot and his companion, and were equally determined and resourceful. Because they were in larger groups made travel easier, and provided more equipment for constructing shelter and acquiring food.

Two of the men, Sergeant Mannett and Lieut. McCandle, were excellent marksmen and with their .45 pistols and a .30 caliber carbine provided much small game which varied the diet and stretched the rations. Incredible as it sounds, the men were able to secure grouse, squirrels, and ducks with these weapons, and food was not such a major problem until ammunition was exhausted.

(Continued on page 39)

food : *water*

TIMELY NOTES ON AN IMPORTANT SUBJECT BY BUMED'S RESEARCH DIVISION

FOOD In warm waters a supply of food contributes much less than water to survival on rafts or lifeboats. However, laboratory experiments have suggested that a daily intake of 75 to 125 grams (roughly 2½ to 4 ounces) of a food constituted of carbohydrate and up to 20 percent fat is more than worth its weight in water because, by decreasing the breakdown of body protein, it reduces the substances that demand excretion by the kidney and thus reduces the daily output of urine. Experiments show that men on rafts whose daily intake of water is limited to about 16 ounces often have little appetite for food and of their own choice consume only 2 to 4 ounces daily. Addition of vitamins to emergency rations for rafts seems unnecessary, since deficiencies will not develop during the short period intervening before all the ration is consumed.

The ingestion of protein will increase dehydration unless additional water is taken in order to compensate for the increase in urine volume which the urea formed from the protein will produce. Emergency ratior use at sea where the supply of drinking water is lir should be low in protein and high in carbohyd the ingestion of the latter food spares body wat already indicated. For the same reason, the am of fish and bird flesh ingested in the absence c abundant supply of water should be limited. flesh averages 15 to 20 percent protein; laborator periments indicate that it is questionable whethe flesh contains enough water to compensate fo increase in urine volume occasioned by ingestic this amount of protein. A necessarily arbitrary is to ingest only small quantities of fresh fish, t or bird flesh—say 10 one-inch cubes, equal ounces—daily when the ration of water is less 24 ounces a day; no dried flesh should be eaten i daily ration is less than 32 ounces. Fish flesh is regarded as a food and not as a source of water perience has shown that it is impossible to "w fluid out of fish, and that attempts to chew fluid c fish actually result in the simultaneous ingestic the protein also.

It seems likely that in cold waters, where exp causes death before thirst does, a supply of fo more important to survival than in the tropics. T is evidence that ingestion of about 600 calori food every 2 hours increases the resistance of the to severe cold. Naval personnel should be info that ingestion of food before abandoning ship a intervals of one or 2 hours on the lifeboat or raft increase the period of survival in cold air and by a few hours.

The emergency ration supplied on Bureau of nautics life rafts in 1944 is representative of a cu trend in emergency rations for use on such craft. three types of food (butterscotch, fruit drops, malted milk to which sucrose has been added) su a high carbohydrate, low protein ration. The and second items contain citric acid to promote of ingestion by stimulating a flow of saliva in mouth. About 85 grams of the ration are pack each small can, supplying approximately 380 cal the total number of cans supplied each raft occ varies with the space available, but is usually at three. At least 50 grams, or half the contents of should be consumed daily. On the life floats an of ships a ration of pork luncheon meat, biscuits malted milk tablets is supplied at the time of wr A total of 3000 calories is stowed on a float or n each man of its rated capacity.

TER In tropical waters dehydration is usually the principal cause of exhaustion ath of survivors. Under the most favorable cirnce a man can survive without water for only) days; a man without food but supplied with nay live for 30 days or more. When the evapwater loss of sedentary, semi-fasting men con; about 100 grams of carbohydrate a day itained at a minimum, the daily requirement of necessary to prevent dehydration lies between d 1000 cc. A figure of 24 ounces (710 cc.) is iverage. An intake of 16 ounces (one pint) of a day may be regarded as absolute minimum is likely to be insufficient to maintain normal ion in some men. The water balance of fastn maintaining hydration by ingesting 24 ounces ɜr daily under conditions of minimum evaporaiter loss may be roughly stated as follows: *availbody,* approximately 700 cc. as drinking water,)0 cc. as water freed from body tissue as it is :onsumed and as water derived from subsequent on of that tissue; lost from body, 400 cc. as and 750 cc. as water unavoidably evaporated ıngs and skin. It is not harmful if the balance tly negative, since the fasting body is consumtissue and can dispense with that water formerly ɔrated in that tissue.

imum air temperatures of 85° F. may be enred in tropical ocean areas. Under such condi:he heating of the body by that direct rays of ›pical sun necessitates dissipation of heat by ed evaporation of body water. The evaporas of water from the body can thus be increased he minimum figure of 750 cc. to as much at :. a day in lifeboats and pneumatic rafts durms in tropical waters. Such a great loss would :ate ingestion of some 2500 cc. daily rather)0 cc. which will prevent dehydration in cooler surroundings. Hence, every effort should be made to observe the measures aimed at cooling the body in the tropics described later in this section, because decreasing the water loss from the body may actually serve to provide it with more water than available from any other source.

Ordinarily no water should be drunk during the first 24 hours after abandoning ship because part of the water ingested during this period will be wasted as relatively dilute urine. (Later, on the other hand, subjects who have become slightly or seriously dehydrated during their stay on a raft can drink large quantities of water (from rain, for example) without subsequently wasting a significant amount of its as urine). After the first day, it seems wiser to maintain hydration and maximum strength as long as possible by issuing each man at least the 16 ounce minimal requirement daily until only about 10 ounces is left rather than to issue smaller amounts over a longer period of time.

Laboratory experiments suggest that it is physiologically permissible to increase one's supply of water by diluting 4 parts of fresh water with one part of sea water. Several practical considerations render it inadvisable to recommend such a procedure for general use. Some physiologists question whether any advantage is gained; at any rate, it is slight. The dilution may be incorrectly executed. In most types of emergency craft, the amounts of sea water thus deliberately ingested will be amplified by indeterminate amounts of sea water and dried salt inadvertently swallowed. The water prepared from sea water by solar stills and by chemical desalting kits often already contain salt in a concentration which should not be increased by addition of sea water.

The ingestion of undiluted sea water is to be prohibited because the diureais, vomiting, and diarrhea which its high total salt content of 3.0 to 3.5 per cent

TABLE OF WATER ALLOTMENTS PER MAN

BuAer Pneumatic Life Rafts

	Water Cans	*Desalting Kits*	*Rain Sheet Equivalent*	*5-Quart Storage Bag*	*Solar Still*	*TOTAL Assured Water*
ꞌararaft Kit	1	2	YES	1	0	5,370
lace Rafts	1	1	YES	1	0	2,850
One-Man Rafts	0	1	YES	2	1	2,520
Multiplace Rafts	0	1	YES	1	1	2,520

table was calculated on the basis that "assured water" included 330 cc. per can and 25 cc. (6 briquets each providing per desalting kit; a "plus" was allowed for solar stills; no allowance was made for collected rain.

causes will increase dehydration. The central nervous system is particularly affected, and delirium is frequently observed as a result of drinking salt water. Sea water should not be introduced into the rectum. There is no evidence that during immersion in sea water useful amount of water pass into the body through the skin. It is questionable whether fish juice, even if one can obtain it, is of benefit to survivors without water. The occasional smoking of a cigarette will not affect water balance unfavorably, although it may temporarily increase thirst.

The *total* amounts of water available to each man on emergency craft varies from the approximately 2 pints of fresh water stowed in the breakers of floats and nets to the considerably larger quantities made available by desalting kits and other devices on pneumatic rafts.

The desalting technique supplied on pneumatic rafts at the time of writing is the Permutit Process employing silver aluminum silicate. This chemical precipitates the chloride ion from sea water as silver chloride and itself combines with and precipitates the sodium; magnesium is also removed. Small amounts of sodium chloride and sulfate remain in the water after treatment.

The following advice bearing on the rationing of water is useful for survivors on lifeboats and pneumatic and drum-type rafts; certain of the stipulations obviously cannot be complied with by those on life floats and floater nets:

1. If possible, take a drink of water before starting off on an aircraft mission or abandoning ship.

2. Unless it is immediately obvious that the procedure will make you cold, after abandoning ship conserve body water by the following measures, which should be temporarily discontinued when they result in sensations of chilliness:

a. Perform no unnecessary exertion.

b. Remove, but do not discard, all clothes save those necessary to protect you from sunburn. Unbutton the front of your shirt.

c. Expose your body thus clothed to the breeze as much as possible.

d. If you can, rig an awning protecting you from the sun but not interfering with the passage of the breeze over the body.

e. Keep your clothes constantly wet with sea water during the *day*. Rinse accumulated salt from them daily. Dry clothes before sundown.

3. Unless you become very thirsty, drink no water for the first 24 hours on the raft.

4. Thereafter, drink one pint (16 ounces) of a day if your supply is limited; drink a pint anc half (24 ounces) a day, or more if necessary, i have an abundant supply of rain water and th pint allowance does not satisfy your thirst.

5. When you have only about 10 ounces of left, use it merely to moisten your mouth and sip rain is encountered.

6. Be prepared to catch rain. If you are succ and have been on a very limited ration of water, your fill slowly over the course of about 1 hour day return to your usual daily allotment of one p

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(*Training pays off—Continued from page 36*)

All of the men attempted to make use of raft the river was so treacherous that only the ad party sent out on the eleventh day met with an cess and they rode only five miles before their raf rendered useless by a log jam. Continuing on this group of three men traveled another week b they made contact with civilians at a small villag

They were greeted in a friendly manner and came the barriers of language by means of ske which showed whence they came and the plig their companions still camped up the river. Th lagers took the men to a larger community where tact was established with the Soviet Army.

A Russian Major who could speak English ac an interpreter. Soviet pilots were present at th interview conducted by the Major, and as soon airmen had a clear idea of the probable positi the other survivors, they commenced the air searc

Once the Americans were located from th rescue parties in boats were dispatched, and until parties reached them; planes located the Ame daily and dropped food and notes with great acc

No detail seems to have been overlooked could have contributed to the survivors' well-l Medical personnel in the rescue parties and a hospitals received high praise.

Although little is known about the Soviet organization, the expert handling of the deta search for the missing crew, once contact had made with the Soviet Army, showed wid perience in the problems of coordinated search, ping of supplies, and in anticipating the needs survivors once they had been found. The repo all the men involved contain nothing but prai the civilians and the members of the Soviet Arm Force, and Medical Corps with whom they ca contact.

Search and Rescue (SAR) Committee of the ·ovisional International Civil Aviation Organ- met on November 14, 1945, in Montreal, . Eight meetings were held working to an of 19 items which had been prepared in the a draft by the AN Committee and adopted SAR Committee. (See Appendix 1.) In g the Agenda the order in which the items ɔe treated was changed by resolution; but for reference the old order is preserved here. vas no request for translation of minutes of s or working documents during the session.

of the Committee's time was spent on Item I ıgenda—"Annex L," Chicago. The terms of e for the Committee with regard to its treat- Annex L are given in a resolution by the AN :tee which instructs that the Annex shall be into two parts; i. e., "Search and Rescue," and gation of Accidents" (See Appendix 2).

ɔns of Annex L have been dealt with in Section .e IX of the Interim Agreement and Article 25 !onvention. In view of the fact that the prin- ɿunciated in the foregoing articles in the In- Agreement and the Convention had been d at a convention level it was considered priate for the Committee to deal further with The remainder of Annex L, when the ma- :aling with the Investigation of Accidents had ‹en out, left a very meagre document.

ɔrehensive documents dealing with Search and had been submitted by the United States and The United Kingdom in submitting com- ıad associated itself with the work of ICAN, : appropriate section from ICAN was, there- aced before the Committee. Comments had :n submitted by Canada and Sweden. These nts were all considered by the Committee along ınex L, and by resolution it was decided to use ıs a basis for discussion.

TREATMENT OF ITEM 1

The "Standards for Search and Rescue" embodies the measures that are considered necessary to implement the obligations of member states under the appropriate sections of the Interim Agreement and the Convention. In order to clarify the status of these standards a resolution was passed. (See Appendix 3.)

It will be noted that SAR provisions of Annex L have been completely redrafted so that it does not follow the pattern of any of the proposals heretofore submitted. The Committee felt that it would be unwise at this time to attempt much detail with respect to this problem. The Committee endeavoured, therefore, to formulate a plan based upon experience which would be universally acceptable and would permit flexibility and permit the incorporation in the program of the many facilities and techniques which have been developed during the war, but regarding which there has not been sufficient exchange of ideas and information to warrant the establishment of detailed procedures.

With this in mind, it will be noted that the *"Rescue Coordination Center"* is the cornerstone of the proposals. It seems obvious that the prompt and efficient coordination of all available Search and Rescue facilities and activities is a primary requisite to successful action. The location and size of this organization will depend upon the facilities available in any particular area and the relative difficulty in ensuring coordination between them. It would seem that the establishment of a Rescue Coordination Center, since it might be part of an existing facility, would not necessarily impose additional burden upon any state. It may well be that in most instances where Search and Rescue activities have already been given thoughtful consideration, the state will merely be required to give a name to the organization already in existence.

It is felt that by placing responsibility in a single unit or organization uniformly throughout the world, valuable exchanges of information will be achieved and effective coordination between areas will result which might otherwise overlap without having readily available a means for coordination.

It may be noted that the use of the phrase "distressed aircraft" has been avoided. This was thought advisable because the word "distressed" has been given a precise meaning in communication procedures, more narrow than is required for Search and Rescue purposes. The proposed Standards, therefore, use the phrase "aircraft in need of Search and Rescue assistance," with the thought in mind that search and rescue

action may be much more effective in some instances where available facilities are put on the alert prior to the need of any rescue action, and may be alerted in many instances in which rescue action will not be necessary.

It was observed that it has been the experience of some that pilots have been loathe to indicate a possible need of help, waiting until assistance was actually required, which has proved detrimental not only to search and rescue activities but also to the acquisition of information which might prove valuable in avoiding future similar situations.

In providing that the Rescue Coordination Center will have authority to terminate the search, insofar as the responsibility of the state is concerned, it was not intended to prevent the continuation of search by private persons or by particular public agencies which might desire to continue it for a particular reason. It was thought that there should be, however, some means for terminating the responsibility of the state and that there might eventually be adopted some formula which all states would follow in determining when their responsibility has been discharged.

The use of the term "rescue unit" might at first appear to be conducive to some confusion, since it is obvious that any organization or, for that matter, individual which undertakes to effect rescue could be a rescue unit. Some term was thought necessary, however, to differentiate between those various organizations other than Rescue Coordination Centers which would be of assistance in such rescue activities, such as police units having personnel and equipment specially trained and useful for use in a particular area within which they are situated. It is hoped that by setting these apart in our thinking, there may be established over a period of time a greater number of units particularly available for search and rescue. It would seem too, that this term would be useful when information is exchanged by contracting states with respect to their experience and organization and whenever standards of training, equipment, or procedures are discussed.

With respect to Sections 11 and 12 of the Standards the Committee felt that there should be some obligation placed upon aircraft in flight and ships under way to furnish all possible assistance commensurate with their own safety. The Committee was cognizant of the fact that the problems connected with the imposition of any such obligation varied in the individual states. It was felt that each state would use such means as were practicable so that some might pass laws, and others rules or regulations, while might find that the best results could be achie voluntary establishment of practices by the int organizations.

With respect to Section 13, the Committee r that in some instances the entry of aircraft into might be attended with some delay which might disastrous to the success of a Search and Rescu sion. It is, therefore, hoped that under this graph, states would provide for this limited pur method for entry which could never result in Such a procedure would have to be establishe permanent basis so that if any necessary prear ments by parties or contracting states would quired in order to take advantage of the pro offered, these could be accomplished.

With respect to Section 14, it is thought for security reasons a state might not wish t mit any search or rescue to be conducted by ai equipment or personnel other than its own, th those areas it should undertake to make the ne search and take the necessary rescue action. further considered, that where for any reas state did not wish to undertake search or rescue it should recommend such action by others.

ITEM 2—DEFINITIONS

Definitions were prepared and approved, a cluded as part of the Standards.

ITEMS 3 TO 20 INCLUSIVE OF THE AGENDA

In dealing with the remaining 17 items it wa that the terms of reference given at Chicago c extend beyond items 1 and 2. It had not been p within the limited time available to provide m of the Committee with advance notice of thes 17 items. It was the sense of the Committee, fore, that it had assembled somewhat insuffi prepared to deal with most of them. Consider importance of a number of them, it was felt would be inadvisable to take precipitate actio that it would be better to defer judgment and d until meeting of a subsequent session.

Because of the importance of the question it is considered appropriate to treat it at thi The suggestion had been made that the princ assessing the cost, against either the owner of t craft or the State of Registration to cover e incurred in Search and Rescue, should be esta internationally. An excellent paper on this (See Appendix 4) was prepared by the Secret

ıllowing comments are given on the urgent f the Committee regarding the remaining

s 3, 16, 18 being closely associated in sense s the work of SAR is concerned, were dealt ·esolution recommending among other things states provide PICAO with all pertinent in- ı on these subjects and that certain meetings : by PICAO to resolve problems connected ı (See Appendix 5).

s 4 and 9 (Weatherstrips) being closely ɜre dealt with by resolution recommending s be taken to retain certain of these facilities ɔendix 6).

5 was dealt with by resolution recommend- the Secretary be authorized to visit regional d carry out such investigations as appeared to the work of his bureau.

6 (Statistical Completion) was discussed length. It was decided that member states ɜ requested to provide PICAO with statistical ɜring Search and Rescue and that this should ɀed by the Secretary and distributed in such as appeared necessary to achieve the most results.

s 7 and 8 being closely associated were h in one resolution (See Appendix 7).

10 (Mutual Aid). The Committee did in a position to express any opinion on this t this time.

11 (Co-operation in search by Airline Oper- The Committee had devoted considerable ıis question in co-operation with the represent- the airline companies. A good part of one had been devoted to discussions with Col. ɔresenting IATA. Pending further advice ΓA the Committee felt unable to make any ndations on this question.

12 (Regional Organization) was dealt with tion (See Appendix 8).

13 (Regional publications). The Com- resolution stated its opinion that it was not in ı to take action on this matter at this time.

14 (Information on Maps). The Commit- ıolution expressed its opinion that it was not ion to take action on this matter at this time.

15 (Sea Rescue in Relation to Overlapping tions) was dealt with by resolution (See : 9).

17 (Review of Work of Other Committees). ınent documents covering the work of other committees were placed before the members. No action regarding this material was recommended.

CONCLUSIONS

In concluding its deliberations the subcommittee expressed a wish that the undernoted items which are of interest because of their association with the question of rescue should be referred to appropriate committees for consideration: ditchability; escape hatches; safety belts; seats; accommodation for equipment; built-in flotation gear; maintenance and inspection of emergency equipment; drill of passengers and crews.

APPENDIX 1

Agenda

Part I

1. Review, and any necessary modification of, draft Annex L as developed at the Chicago Conference.
2. Recommendations for the development of consolidated lists of definitions pertaining to Annex L.
3. Development of standards of adequacy of Search and Rescue.
4. Consideration of the need for continuance of United States Navy and British Admiralty North Atlantic weather and rescue patrol stations, as well as weather and rescue patrol stations in the Pacific.

Part II

5. The determination of subjects for special, intermittent or continuous study of the Secretariat in the field of interest of the Sub-Committee on Search and Rescue.
6. Determination of subjects requiring either special or continuous statistical compilation relating to the field of interest of the Sub-Committee on Search and Rescue.
7. Determination of policy governing collection and maintenance at PICAO Headquarters of current files of aeronautical publications relating to Search and Rescue, Procedures and Practices issued by national governments or other agencies.
8. Consideration of PICAO publications as relating especially to the field of interest of the Sub-Committee on Search and Rescue.
9. Development of recommendations with respect to the provision of Search and Rescue facilities on the high seas or areas of undetermined sovereignty.
10. Development of recommendations for mutual aid for the provision and maintenance of adequate systems for Search and Rescue.
11. Consideration of the extent to which international airlines or groups of airlines might conduct Search and Rescue.
12. Consideration of the need for and desirability of establishing special regional search and rescue organizations for particular areas or routes.
13. Consideration of standards or recommended practices for national publications in the field of Search and Rescue.

14. Consideration of the type and amount of information regarding Search and Rescue facilities and services that should be represented on maps.

15. Consideration of the relations and coordination of activities with international organizations whose field of interest overlaps that of the Sub-Committee on Search and Rescue.

16. Consideration of possible action by PICAO in coordination with research and development work in the field of Search and Rescue with the member states.

Part III

17. Review and integration of the recommendations with regard to Search and Rescue facilities and services submitted by the Sub-Committees on Meteorology, Rules of the Air and Air Traffic Control, Communications and Airline Operating Practices.

18. Development of a standard of good practice for the guidance of officials responsible for the implementation of the recommended standards of Search and Rescue.

19. Consideration of the methods of financing actual Search and Rescue operations.

APPENDIX 2

FINAL REVISION OF SEARCH AND RESCUE PROVISIONS OF ANNEX L OF THE CHICAGO CONFERENCE AS FORMALLY ADOPTED BY THE SAR SUB-COMMITTEE ON 23 NOVEMBER 1945

1. *Definitions.* Rescue Coordination Center: A center established by the appropriate authority to initiate, coordinate and terminate Search and Rescue within a designated area.

Rescue Unit: A unit composed of trained personnel and provided with equipment suitable for the expeditious conduct of Search and Rescue within a defined area.

To Alert: To alert means to direct an area control, rescue unit or other assisting organization to stand guard on some radio frequency or stand by prepared to proceed on a mission.

II. The provisions of these Standards are to have effect whatever the nationality of the aircraft or persons on board believed in need of Search and Rescue assistance.

III. For the purpose of these Standards, aircraft shall be considered to be in need of Search and Rescue assistance in the following circumstances:

(a) When information is received that an aircraft has definitely made a forced landing or is about to do so.

(b) When information is received which indicates that the operating efficiency of an aircraft has been impaired to the extent that a forced landing is likely.

(c) When overdue as defined for the particular route or region concerned.

IV. Organizations and procedures recommended in these Standards shall be established by each Contracting State so far as may be required by the flight of the aircraft ov and water areas, and so far as may be practicable.

V. Contracting States shall collaborate with neighb states, whether Contracting or non-Contracting, an any regional organization, to ensure the proper co tion of Search and Rescue measures.

VI. Contracting States, separately or jointly with States, shall establish Rescue Coordination Centers purpose of initiating and coordinating the employm public and private facilities for Search and Rescue designated areas and, insofar as the responsibility State or States is concerned, terminating such action. Coordination Centers may be a separate facility or of an existing service. The area to be assigned to a Coordination Center shall be as defined by the S States whose territory, or part of whose territory is in in the area, or as agreed by any regional organization may be set up for the purpose. By mutual agreem tween the States concerned, such area may be ex beyond their territories without regard to national boun

VII. Contracting States are recommended to arra the establishment of Rescue Units adequate to c Search and Rescue operations in areas within whic necessary to provide Search and Rescue operations. Rescue Units may be a separate facility or a special an existing service and should be composed of traine sonnel and provided with equipment suitable for t peditious conduct of Search and Rescue within a area.

VIII. In those regions for which no Rescue Co tion Center is established, Contracting States shall ma arrangements as are necessary and practicable to ens utilization and coordination of any facilities availabl

IX. Contracting States shall arrange, and shall ma arrangements known as widely as possible within th ritories, for transmission, by the best means available, Rescue Coordination Center and any other appropri thority, of information regarding aircraft believed i of Search and Rescue assistance.

X. On receipt of information that an aircraft is i of Search and Rescue assistance, a Rescue Coord Center shall immediately initiate action to ascertain cation of the aircraft and to provide all necessary ai

XI. Whenever a Rescue Coordination Center quested the alert or use of a Search or Rescue fac shall notify the operator of that facility as soon as su or use is no lnger necessary.

XII. Contracting States shall make all reasonable to secure the cooperation of aircraft in flight, and ship way, in maintaining a lookout for aircraft believed in Search and Rescue assistance and in forwarding with lay, to the Rescue Coordination Center concerned, an mation regarding the position and condition of such a

XIII. Contracting States shall also make all rea efforts to secure the cooperation of their local authori of all ships and aircraft under their jurisdiction in a in the rescue and welfare of survivors of distressed airc

XIV. Contracting States are recommended to est definite procedure to facilitate entry of aircraft, eq and personnel, permitted by the State of Registratio aircraft in need of Search and Rescue assistance, purpose of conducting Search and Rescue operations

ı any area, other than a prohibited area, within nay be reasonably considered that the aircraft is Such Search and Rescue operations and the entry :craft, equipment and personnel shall be subject to ions of the laws and regulations in force in the ıg State in whose territory the aircraft is in need of d Rescue assistance.

the event of Search or Rescue action being neces- prohibited area, the Contracting State, in whose he prohibited area is situated, itself shall arrange d Rescue operations in that area as may be prac- ‹ing into account facilities offered by the owners of 't or the State in which the aircraft is registered.

e: In paragraph II above the word "Standards" is rpreted as "statements of principles."

APPENDIX 3

NG RESOLUTION

ideration of the following Resolution:

IEREAS: The PICAO Secretariat has been in- ed by the SAR Sub-Committee to carry on studies phases of Search and Rescue and to visit installa- necessary to observe Search and Rescue practices ıe purpose of appraising the information and ex- ıce gained to disseminate the knowledge to all of Iember States.

w THEREFORE: Be it resolved that the Search and .e Sub-Committee recommend to PICAO that the h and Rescue section of the Air Navigation Bureau .arged by one Search and Rescue Expert in Grade 4. ideration of the following Resolution:

it resolved that the Secretary of the SAR Sub- nittee be given authorization to correct outstanding tes, and to make editorial corrections in documents, :o prepare the Agenda for the next Search and .e Sub-Committee session in advance, so that all ɔer States can study same before the session is ned.

secretary would like instructions regarding the s of any of the SAR documents into any other

APPENDIX 4

F SEARCH AND RESCUE

ase of a private aircraft crossing the boundary line ountry of origin to a foreign state and becoming n an accident during its stay in the territory of state, we must determine:

Who should bear the cost of Search and Rescue

Whether there is either nationally or interna- ly a system of insurance or provisions for the post- a bond to cover such cost

What will the conditions under which custom ıtions will be waived in favour of aircraft and ınel crossing the border to aid in the search and : in accordance with article 25 of the Chicago :ntion.

We intend to discuss here only questions (*a*) and (*b*) and to examine question (*c*) in a subsequent paper.

It should always be remembered that the liability of an aircraft owner or operator for an act arising out of the use of his aircraft may be both a liability in tort and a liability for breach of contract. We are concerned here only with the former.

The liability of an aircraft owner or operator for any actionable wrong committed by means of the aircraft when in flight in respect of land, or any damage to property or injury to persons on the surface, is governed everywhere by the statute or common law of the place where the accident occurred, and, in some countries only the Convention of Rome may be applicable.

It follows therefore that in order to determine who should bear the cost of (*a*) search, (*b*) rescue, (*c*) compensation to third parties, it is necessary to determine first who bears the responsibility.

Having once determined who is responsible we will be able to infer logically who is to pay for the operations which may limit the financial responsibility.

Although the responsibility of the owner or operator of the aircraft is largely determined in each country by local law, it seems that the general principles according to which these various local laws are applied do not vary considerably when their final result is considered, i. e., the fixing of the responsibility for payment on the owner or operator, and are furthermore not greatly at variance whatever be the nature of the goods to which damage is inflicted. In other words, whether the damage is inflicted to private property or to state property (forest fires, damage to government buildings, etc.), the assessment of the indemnity is determined according to the same standards.

Moreover, the existing laws fixing responsibility on the owner or operator of an aircraft, do so objectively, especially in the United States, in England and in France, since these laws establish that the airman is responsible for the damage caused by him, whether this damage is due or not to his own negligence.

The claimant, therefore, does not bear the burden of proof. In most cases, anyway, the claimant could only establish this proof with difficulty and the aforesaid laws thus at variance with the common law, seem to be sanctioned by the Rome Convention: (article 2, para. I).

> (1) "The damage caused by an aircraft in flight to persons or property on the surface shall give a right to compensation by the mere fact that it is established that the damage exists and that it was caused by the aircraft."

Having thus fixed, in all cases, responsibility on the owner or operator of the aircraft, it follows logically that he also has to bear all the cost of search and rescue since it is his interest to try to limit the extent of the damages which he will have to compensate, either by undertaking, or causing to be undertaken, operations the success of which frequently hinges on the speed with which they are started.

This brings us to consider the modern means of search and rescue employed in aeronautics. It seems obvious that, since international air routes and private international air travel are headed towards a vast expansion unknown heretofore, search and rescue facilities which should be provided

in far-away places involve expenses and organization on such a scale that they could not possibly be established otherwise than by government action or through vast private enterprises, either subsidized by governments, or supported cooperatively by the airlines with the help of the international air touring associations which may be formed.

Let us consider therefore the case of a private aircraft registered in the United States and involved in an accident in the Canadian far North. It is obvious that the original search and rescue operations could be initiated with far greater speed by a Canadian search and rescue organization, whether this organization be a governmental or a private enterprise.

Even if we suppose that the owner or a similar search and rescue organization in the United States are advised of the accident immediately, the time which would necessarily elapse before American means of search and rescue could reach the scene of the accident in the Canadian far North might perhaps spell the difference between success (salvage of human life and of merchandise) and total failure.

It seems therefore that the time element must be taken into account and that it would be advantageous to provide for immediate action by the official search and rescue organization of the state on whose territory the accident occurs, whether this organization be state-owned or an accepted private company, and agree also on well defined methods of compensation for such an intervention, fixed in advance, and which would become automatically operative.

Should the search become a long drawn undertaking, it seems that the owner or operator of the aircraft would be better off by replacing the initial search and rescue organization either by a corresponding official organization from his own state or by a private company which he would hire to continue the operations, either one of these methods being possible as a result of the application of article 25 of the Chicago Convention which permits aircraft and rescue personnel to enter the territory of a state where an accident has occurred.

Another point which must be mentioned here is that besides compensation due to the specialized organization undertaking search and rescue, compensation is also due to aircraft, ships or private individuals who happen to be on the spot when an accident occurs and who render assistance. Article 3 of the Brussels Convention is very clear on this point:

> 1. Any assistance rendered . . . shall call for an indemnity based on the expense justified by circumstances, as well as the damage suffered in the course of operations.
>
> 2. If the assistance was rendered in the absence of any obligations to do so, the assister shall have no right to an indemnity unless he has obtained a useful result by saving persons or by contributing thereto.
>
> 3. The indemnity shall be payable by the operator of the aircraft assisted or by the owner or *armateur* of the assisted ship. . . ."

Furthermore, article 9 of the same Convention reads:

> "(1) The remuneration due for the operations of assistance or salvage shall be payable by the operator of the assisted aircraft, or by the owner or *armateur* of the assisted vessel, in accordance with the national with contracts governing the vessel.
>
> (2) The operator of the aircraft shall have course against the owners of goods for such the remuneration as pertains to assistance and sal such goods. However, this recourse shall be de reduced if it appears that the assistance or the of the goods has been rendered necessary by an the operator of such a nature as to render him li the owners of such goods.
>
> (3) The owner of the goods may, in all ca paying such part of the remuneration as pert assistance or to salvage of his goods, or by de suitable security for such payment, obtain the of the goods by the operator and the release goods that may have been attached.
>
> (4) The recourse of the owner or of the *ar* of the vessel against owners of goods shall rema ject to maritime rules."

Consequently, since compensation to a third party ing assistance because of his fortuitous presence spot is thus unequivocally attributed to the owner or o of the aircraft involved, it follows, *a fortiori,* that the organized search and rescue must be similarly borne same owner or operator.

This brings us to part (*b*) of the question such as set forth at the beginning of this paper: is there in ex either nationally or internationally, a system of insur provisions for the posting of a bond to cover the search and rescue? There does not seem to be. Nc sion is made, either in the Chicago Convention no Annex L, for the source of the necessary funds.

The Brussels Convention is also silent on this poin

Only the Rome Convention touches on the subject posing a system of international insurance, not to co cost of search and rescue, but only damages to third

On the national plan, in the short time we have be to give to the drafting of this paper, we have found leg only in the United Kingdom whose Air Navigation 1920 anticipates and whose Air Navigation Act of 19 into force the provisions of the Rome Convention, n for British aircraft flying over British territory, but British aircraft flying over foreign territory and for aircraft flying over British territory.

The principles thus adopted in England are very tageous from a national point of view. Whether tl be adopted internationally also is precisely what will be determined since there is nothing to go on s whether or not the same principles may work internat If all the states had adopted similar measures it wou been easy to check on the efficacy of the principles set the Rome Convention on an international plane. H it has never produced the results which were expect since the reglementation it set forth was incomplete. I more from a practical point of view, there has never existence any kind of insurance covering all possible

Save for the consequency of the neglect to insur the Convention of Rome, and the definition and lir of the rights of insurers and Third Parties containe Protocol thereto, there is no international private la ing to the insurance of aircraft, and therefore the Co Laws has to be considered.

conflict does not often occur in the English Courts e the general rule there applied to insurance contracts they are, and the liability under them is, governed by v of the country where the contract is made, which is also the country where it is intended to be performed.

lly, only a very few states accepted the Rome Con- n and any international Convention, however worth- remains inoperative as long as it is not adhered to by ient number of states. All governments are at liberty fy or to withhold ratification of any convention, and re bound only by those provisions in the convention agree, or do not conflict, with their national legisla- which in turn implements the provisions by providing ns for non compliance. It seems that the initiative by the United Kingdom is deserving of consideration er countries and that the compulsory insurance sys- rganized in Britain may serve as a model for an zation which would meet the requirements of inter- al aeronautics.

APPENDIX 5

following Resolution was moved by U. K. and sec- by France:

)LUTION SUBMITTED BY THE UNITED NGDOM FOR AGENDA ITEMS, 3, 16 AND

EREAS: Detailed standards of adequacy for search and organizations and equipment must be based on the practical experience; and

EREAS: Notification of this item (item 3) on the SAR did not permit time for the assembly of the data al to the preparation of such standards at this session SAR subcommittee; and

EREAS: As a result of wartime operations in search and this data exists in military records and experience on unlikely to be approached in peacetime; and

EREAS: It is possible that the need for reduction and loyment of military resources may lead to this dis- and dissipation of this military data and experience omparatively early date; and

EREAS: The dissemination of information concerning rds of adequacy and the reaching of agreement thereon atters vital to the provision and efficiency of search scue organizations and to international collaboration ı;

V THEREFORE BE IT RESOLVED: The Search and Rescue ommittee recommends that:

Contracting States send to PICAO all pertinent in- ion in their possession on standards of adequacy, for ribution by PICAO to Member States as a matter of riority.

Contracting States appoint such technical and other s as they consider necessary to examine the informa- ceived from other States, to compare it with their own, prepare comments on such differences or omissions as onsider would affect efficiency or international collabo- in search and rescue.

(*c*) PICAO should arrange for a meeting as early as practicable for a conference of such technical and other authorities as States may nominate to discuss and reach the highest practicable degree of agreement in detail on standards of adequacy, these standards to include among their headings, Procedures, Equipment and Facilities, Operations, Medical Aspects, Records, and Statistics.

(*d*) PICAO should arrange for a further meeting of the Sub-Committee on Search and Rescue to take place as early as practicable after the meeting proposed above, or concurrently with it as early as possible and not later than six months from the end of the present session of the SAR Sub-Committee.

NOTE.—Representatives of airline operating companies will presumably be invited to attend any discussions concerning the recommended scale of survival equipment to be carried in aircraft.

APPENDIX 6

RESOLUTION—SAR SUB-COMMITTEE UNANIMOUSLY PASSED 22 NOVEMBER 1945

WHEREAS: Ocean station vessels provide an important means of Search and Rescue, independent of additional services such as meterological observations, navigational aids, and communications which they may provide; and

WHEREAS: There are at present a number of such ocean station vessels in the Atlantic and Pacific Oceans maintained by the Allied Governments to meet current military requirements;

NOW THEREFORE BE IT RESOLVED: That Contracting States whose military agencies are now maintaining such ocean station vessels be asked by PICAO to continue in those areas flown or to be flown by civil aircraft, as many of such stations as may be practicable for a reasonable length of time after curtailment of military operations to allow for the determination of civil aviation requirements and the conclusion of the necessary arrangements for meeting such requirements, and for determining a fair apportionment of costs.

APPENDIX 7

RESOLUTION SUBMITTED BY THE UNITED STATES FOR AGENDA ITEMS 7 AND 8

WHEREAS: Agenda Item Number 7, entitled "Determination of policy governing collection and maintenance at PICAO Headquarters of current files of aeronautical publications relating to Search and Rescue, Procedures and Practices issued by national governments or other agencies" and

WHEREAS: Agenda Item Number 8, entitled "Consideration of PICAO publications as relating especially to the field of interest of the Sub-Committee on Search and Rescue" are closely related and necessarily a combined problem of assembling and dissemination of information; and

WHEREAS: It is acknowledged that Contracting States are not interested in every publication on the subject of Search and Rescue received at PICAO Headquarters; and

WHEREAS: The distribution by PICAO of the vast amount of material published throughout the world on Search and Rescue is considered unnecessary and impracticable; and

WHEREAS: A reference library of carefully selected publications on the subject of Search and Rescue is desirable and necessary; and

WHEREAS: The comprehensive collection, compilation and issuance on a semi-annual basis of statistical information from all Contracting States on a standard form provided by PICAO is necessary; and

WHEREAS: The necessity of organizing, editing and publishing a periodical is not apparent at this time; and

WHEREAS: "The Air Sea Rescue Bulletin" published by the Air Sea Rescue Agency of the United States is a recognized, authoritative, official, monthly publication with wide circulation which can be made available to Contracting States.

NOW THEREFORE: The Sub-Commitee on Search and Rescue recommends:

(*a*) that PICAO be furnished with carefully selected publications on Search and Rescue by Contracting States which will be documented, referenced and accessioned. Contracting States will be furnished with the titles, a brief description of the contents and source of each publication on an accessions list.

(*b*) that the Search and Rescue Secretariat, prepare and distribute to Contracting States a standard statistical form on which will be recorded Search and Rescue statistics and returned to the Secretriat, involving aircraft and persons on board. Semi-annually statistical totals with the necessary break-downs will be furnished Contracting States.

(*c*) that the "Air Sea Rescue Bulletin" be arranged by PICAO to be sent to Contracting States.

WHEREAS: The new publication (JANP–300) entitled the "Air Sea Rescue Manual" covers all phases of rescue operations in a most adequate fashion;

NOW THEREFORE: Be it resolved that through the services of the PICAO Secretariat, arrangements be made to have this publication sent to Member States.

APPENDIX 8

RESOLUTION—SAR SUB-COMMITTEE UNANIMOUSLY PASSED 23 NOVEMBER 1945

WHEREAS: International civil aviation on a scale hitherto unprecedented raises many problems in connection with the Search for and Rescue of survivors of lost aircraft, which concern certain groups of States, associated by reason of their geographical position with particular well defined areas or route; and

WHEREAS: The necessity for promoting joint action on the part of such States, in respect of their participation in Search and Rescue operations to the extent of establishing and maintaining facilities therefor is apparent.

THEREFORE BE IT RESOLVED THAT: The SAR Sub-Committee recommends that the proper development of procedures to implement the PICAO international standards and recommended practices relating to Search and throughout the world requires the establishment of organizations; that such regional organizations sho brace such fields of operation in air transportation PICAO Council may determine including Search and and in the latter field the purposes of the regional o tion, in addition to the implemention of PICAO inter standards and recommended practices, should be to:

(1) Encourage airline operating agencies to amongst themselves a joint organization for mutual respect of Search and Rescue, coordinated by the app international organizations.

(2) Coordinate the various control and commu systems in use for Search and Rescue purposes.

APPENDIX 9

RESOLUTION—SAR SUB-COMMI UNANIMOUSLY PASSED 23 NOVE 1945

WHEREAS: It is recognized that the basic respo among interested States and the broad principles o tion in connection with the overall safety and sea rescue efforts, are generally similar regardless of t ticular means of transportation involved; and

WHEREAS: It is also recognized that in ocean are ties maintained primarily for surface navigation and Search and Rescue could be used advantageously craft; and

WHEREAS: Several States are at the present time in preparing proposals for the modification of the International Convention for the Safety of Life (London 1929);

NOW THEREFORE BE IT RESOLVED: That the Con States take advantage of the opportunity offered by Safety of Life at Sea Conference, by recommending the agenda of that Conference a proposal be incl establish an international organization relating to operations which would maintain liaison and coor with PICAO with a view to determining the desira a separate Convention or other appropriate means laboration on the broad subject of safety of life on sea, and in the air under which PICAO and the maritime organization would participate on matter their respective jurisdictions to the end that unifo established in the field of safety, search and rescue its phases.

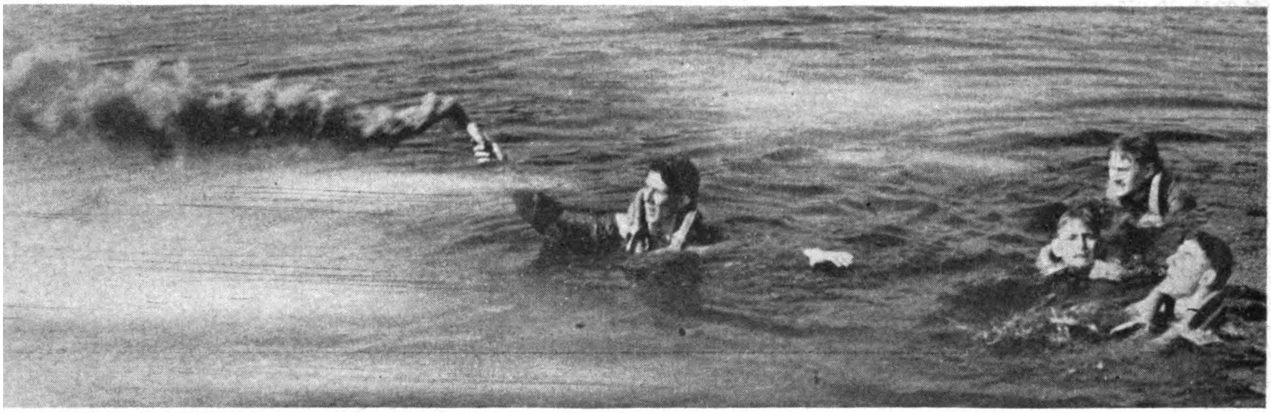
"If, through the proper publicity, there is broug to the public a realization that the great ocean w not, in fact, water deserts, but are figuratively un tinuous patrol, and that there is constantly awaitin a highly-trained organization especially equipped to disabled aircraft and forthwith rescue its passen fears of many potential travelers by air, especia flighters, may be dispelled."

From a paper delivered by Mr. Joseph Pi Committee, PICAO.

RVIVAL
AND DEATH
COLD WATER

"In the case of the Titanic disaster it seems old rather than drowning was the chief cause th. After the liner foundered—sea temperature 28° F.—cries were heard from people in the from ten to twenty minutes afterwards (some ses said an hour). Dead bodies were picked th life-jackets intact and the hands and faces of the water." This quotation is taken from *reck-Survivors,* Study by Surgeon Captain Macd Critchley, RN. Critchley cites many other ces of death following shipwreck due to excesody cooling rather than by drowning.

earch carried out during the war has established pected duration of survival in water at any tem-



ıre and now serves as a guide. Underlying prac-levelopments in methods of protection is a basic standing of the physiological and physical factors ed in cooling the body by water.

ING POWER OF WATER

ıling occurs so rapidly in water because water ces the layer of still air which normally encom- and insulates the body. Body heat is lost in more than twice as fast as in air at the same rature. Since water removes from ordinary the entrapped air responsible for the insulative , clothed men in water are little better off than vithout it.

ATION OF SURVIVAL IN WATER

duration of survival in water depends upon the rature of the water. In water at 85° F. the body must increase heat by shivering in order to prevent a serious lowering of body temperature. In only slightly colder water, shivering must be very intense to maintain a balance between heat production and heat loss. Shivering of this intensity is extremely fatiguing and probably cannot be maintained for many hours. In water still colder, body cooling proceeds rapidly although shivering is intense. In water much below 60° F., most men will die after an hour or two.

Large regions of the ocean are dangerously cold. In August much of the North Atlantic and North Pacific above a latitude of 40° is colder than 70° F. In January the whole of the Atlantic and Pacific above 25° N. is colder than 70° F.

PROTECTIVE MEASURES

Excessive chilling can be prevented by use of watertight suits which prevent wetting and loss of insulative value of clothing worn beneath. Survival in the coldest ocean water for an indefinitely long period of time is theoretically possible if sufficient clothing is worn beneath them and leakage does not occur.

Men abandoning ship, not equipped with anti-exposure suits, should take with them rain coats or other water-impermeable articles to wrap about the body. These will not provide protection in water but will be valuable on a float or raft. Survivors must board a raft or float quickly before becoming too weak. Once aboard, clothing should be wrung out. The raincoat or other impermeable articles should be fixed securely about the body to retard evaporation from the wet garments beneath. Survivors should huddle together with bodies pressed as closely against one another as possible and should shield themselves from wind and water.

C. R. Spealman, Lieutenant, H(S), USNR

U. S. GOVERNMENT PRINTING OFFICE: 1946

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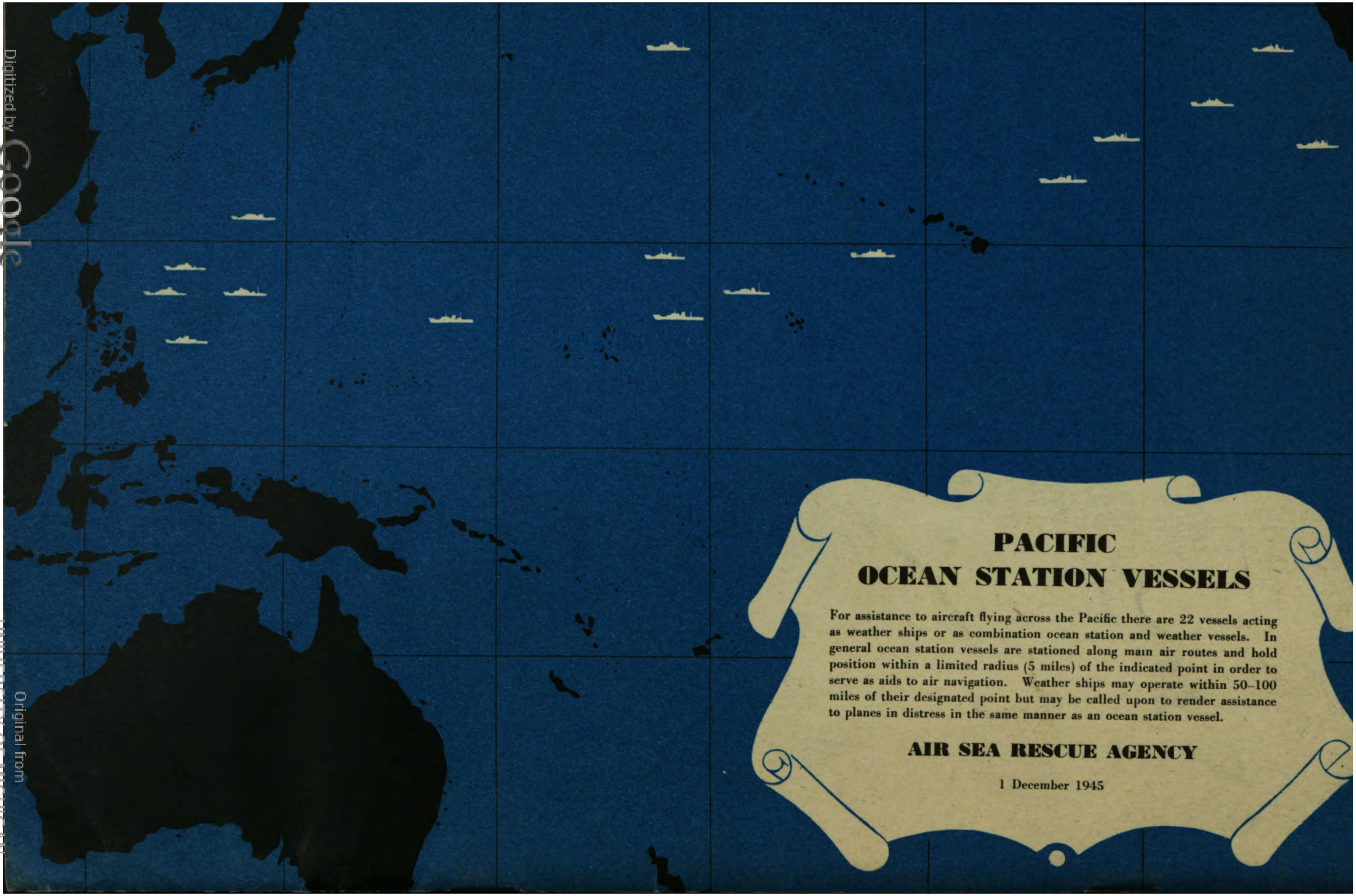
PACIFIC
OCEAN STATION VESSELS
For assistance to aircraft flying across the Pacific there are 22 vessels acting as weather ships or as combination ocean station and weather vessels. In general ocean station vessels are stationed along main air routes and hold position within a limited radius (5 miles) of the indicated point in order to serve as aids to air navigation. Weather ships may operate within 50–100 miles of their designated point but may be called upon to render assistance to planes in distress in the same manner as an ocean station vessel.
AIR SEA RESCUE AGENCY
1 December 1945

Air Sea Rescue bulletin

MARCH 1946
NAVCG 128, Vol. III, No. 3
MONTHLY

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Air Sea Rescue

NAVC

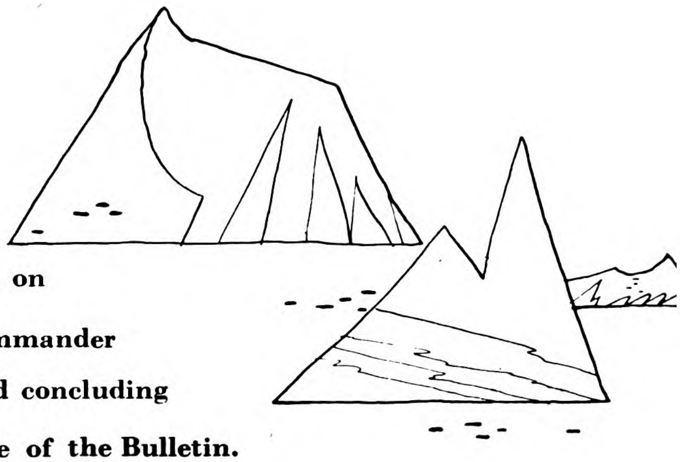
Air Sea Rescue bulletin

NAVCG 128 VOL. III NO. 3 MARCH 1946 RESTRICTED

PUBLISHED MONTHLY BY THE U. S. COAST GUARD FOR AIR SEA RESCUE AGENCY, 1516 14TH STREET NW., WASHINGTON, D. C.

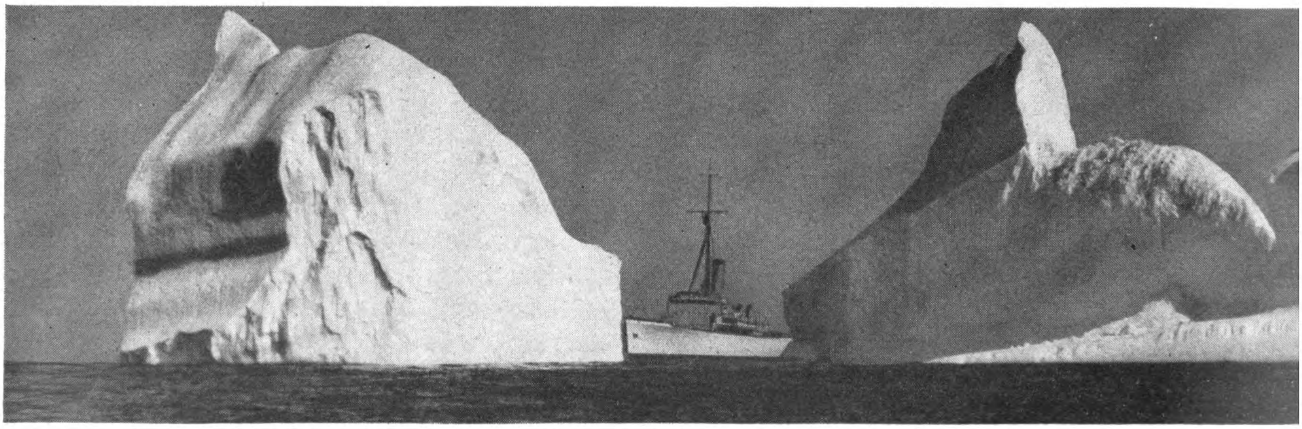
Page

THIS MONTH'S COVER . . . hardly requires description, so well does it portray—in the faces of these three British merchant seamen—the desperate ordeal of their fight for survival. Victims of a torpedo attack on their ship in the North Atlantic, they are here shown being rescued by a Coast Guard combat cutter. *Coast Guard Photo.*



This is the first of two articles on the International Ice Patrol by Commander N. G. Ricketts, USCG. The second and concluding article will appear in the April 1946 issue of the Bulletin. Commander N. G. Ricketts, a graduate from the Coast Guard Academy in 1920, has a long career as a seagoing Coast Guard officer. In 1926-27, as understudy to the present Rear Admiral E. H. Smith, a noted Coast Guard Ice Observer and Oceanographer, he engaged in his first ice patrol duty. In 1928 he became Ice Observation Officer and served in that capacity durin each ice season through 1931. Between ice seasons he a student in oceanography, glacial geology, and oth related subjects at Harvard Graduate School of Arts Sciences. Commander Rickett's hobby of photography has resulted in one of the most complete pictorial records known on ice patrol. The wide use of these pictures in educational lecture work has done much to arouse interest in the important services ice patrol renders the maritime interests.

iceberg Ho!



The Coast Guard cutter "Tahoe," on international ice patrol, viewed from between the double peaks of a huge drydock

IN 1946 the International Ice Patrol will be resumed in the western North Atlantic Ocean after a second interruption due to war. The first interruption was for the seasons 1917 and 1918, but the second has been for a longer period, for there were no regular patrols during the years 1941–45. Let us hope that the next interruption of this service for the benefi shipping will not be caused by war but by lack of or by further scientific advances that will make patrol no longer necessary.

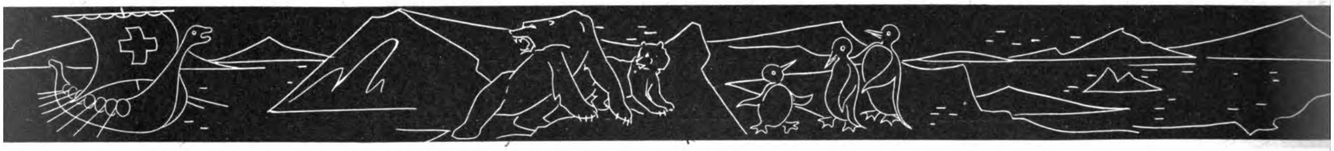
At the present time ice patrols are needed for protection of shipping because we are living in a r

ɔeriod or, at least, in the shadow of a great The evidence of geology shows that there ɜn a number of glacial epochs in the past and y have been, like wars, not only destroyers of e and animal life but changers and developers There is much truth in the expression "The ind made the Vikings." Therefore, it is quite ː that the development of man to his present intelligence and ability has come about largely the stimulus of cold and the need for him to hardihood and initiative to survive the severe ıtill prevalent in so many areas.

gists state that about 75,000 years ago the onditions were far more intense than they are Great ice caps, in places many thousands of k, then covered most of North America north York City. The slowly moving ice caps and which tore up the country in their retreat have ind plain evidence of their work. Even the n geology can readily note the work of the ice ' places in the glaciated areas. Long Island, ıland, Nantucket, Martha's Vineyard and the ırther east are remnants of the great terminal

caps existed 75,000 years ago in many other now fairly temperate parts of the world besides North America. All together they then held in solid form on the land so much water, now back in its normal place in the sea, that mean sea level throughout the world at the height of the last glacial epoch was probably about three hundred feet lower than it is today.

At the present time enormous ice caps still remain on Greenland and on the Antartic continent. Smaller ones exist, where favorable conditions for them prevail, on some of the other land masses of high latitudes. The area and approximate average thickness of the remaining glacial ice of the world can be roughly estimated without much difficulty. The computed volume shows that there is so much glacial ice still left that if all of it melted suddenly, mean sea level throughout the world would be raised almost 100 feet. However, we need not worry about the accuracy of our charts or the safety of our port facilities, lowland buildings and homes. The retreat of the ice is so slow that there has been, at least until recent years, considerable doubt in some quarters as to whether the ice, on the whole, is or is not retreating.



ː or pile of fine ground rock, soil, sand, and ꞅ that was pushed southward and which marks hest south advance of the ice.

ı of this terminal moraine the countryside is rikingly different from that in the unglaciated to the south and west. To the initiated obt often looks as though the land had been by a sheet of sandpaper held in a giant hand, lpaper having been composed of ice shod with ınd, gravel, and boulders. Although the ice v retreated far to the northward, in many north of the farthest advance loose glacial an be found piled high, while in other places othed bed rock is at the surface because, as yet, ıs not been time enough since the last glacial ː for the formation of a covering layer of soil of the name. In the glacial area, mountain vere rounded and worn down and many lakes such as the Finger Lakes of New York State. ːomparatively few mountain and other glaciers y on the North American continent are the ng remnants of the once great ice sheets. Ice

All glaciers and ice caps are, of course, fed by snowfall. When the annual snowfall is greater than the annual melting and wastage, they grow. When their nourishment is less than attrition, just like an animal or plant, they dwindle. It would probably take only a 3° or 4° lowering of average annual temperature to start the glaciers and ice caps growing apace, and as they got larger, they would tend to chill their surroundings and to grow even faster. So close is the balance of nature that it is not beyond the realm of possibility that an atomic war in the future might cause disturbances through increased smoke and dust in the upper atmosphere or other means whereby a rapid return of severe glacial conditions would be brought about. A victorious power in such a conflict of the future might find a cold shoulder from the north pushing it not only from its conquests but from its own lands as well.

Let us now turn from general background matters and speculation to consider the Greenland ice cap, for it is from a portion of the western edge of that cap that most of the bergs originate which menace the

principal steamship lanes between Europe and North America. Glacial conditions approximating those that once prevailed on North America as far south as New York City still prevail in Greenland. The interior of the country is covered by a tremendous dome of ice exceeding 500,000 square miles in area, and in its central portions attaining heights up to approximately 2 miles above sea level.

The snow from which such ice caps are formed begins to consolidate, soon after its fall and eventually turns into hard milky ice. Now all ice under heavy pressure can move or flow, acting much as though it were more or less plastic. The Greenland ice cap, therefore, since it is apparently being nourished faster than it melts, overflows its edges. Bergs break off and drift away on the sea. It is as though soft, white frosting were continually being poured onto the top of a large round cake. After the central position is built up to a certain thickness, all the excess icing flows over the edges. More flows over near where the nourishment is greatest and where the cake's edges are lowest or easiest to cross. Similarly, in Greenland, the excess ice is pushed or drained into the sea through

glaciers that in many places run through or across the narrow rim of the rocky country that today, because of ice retreat, even in Greenland, lies exposed along much of the coasts.

Most of the ice that reaches tidewater does so through the troughs of the great Greenland glaciers, many of which are several miles across. In Greenland we find the fastest moving glaciers in the world. So powerful are they that their motion is about constant, winter and summer. Actual measurements show that some of them move at rates exceeding 50 feet a day.

Besides the ice from glaciers, another kind is found in parts of the northwestern North Atlantic Ocean. It is called pack ice or field ice, which is the flat ice with some salt in it that is frozen on the surface of the sea at high latitudes in enormous quantities each winter. It forms at fairly low latitudes where the winters are extremely cold, even interfering at times with navigation in the ports and bays of the northeastern United States.

Each winter this pack ice dams in the most productive Greenland glaciers. In southern Greenland where the winters are not cold enough to p much pack ice the glaciers are no longer very p tive. When the northern pack ice melts, or up and moves away from the coast in the summ winter accumulation of bergs off the glacier move out to the sea by the thousands. The drift about, mainly under the influence of tid ocean currents. These great fleets of bergs a mented daily by the summer production of the g Only the solid freezing of the surface of the se the onset of winter stops the breaking off and c away of the bergs from the important Gre glaciers.

Few, if any, of the bergs from the north, e south portions of Greenland survive to drift principal North Atlantic steamship lanes. The currents are such that the bergs are not normal ried down toward the Grand Banks. They ge melt while still in the waters near their native The glaciers along the central part of the wes of Greenland are the ones that produce the ber get into the Labrador current and drift far to the

The ice observation studies of the Internatio Patrol have shown that each year the Greenla cap discharges into the sea a total of many billi of glacial ice. Some of it is in small pieces th melt, but most is in the form of bergs ranging from smaller ones, the size of a tugboat, to larg much bigger than the liner *Queen Mary*. It known that some of the bergs are of great siz September 14, 1940, for instance, the U. S. Guard cutter *Northland,* while on an ice-obse cruise, sighted in the western part of Baffin flat-topped berg about 45 feet high and over in diameter. The largest berg ever recorded northern hemisphere was also found off the Baffi coast. It measured 7 miles by 3½ miles. Suc are unusual even in the far north because the of the glaciers are usually tortuous and their ro toms are often uneven, rough and steep. Th other factors break the ice up into chunks whic in size, depending on special conditions at each g The large Antarctic type of bergs mentioned undoubtedly come from one of the few points the Greenland ice cap itself still flows out to t

strip. Bergs from the Antarctic continent nes far larger than the largest berg men- /e.

ve-water portions of bergs that survive to › the latitude of Cape Race, Newfoundland, eed 1,000 feet long by 300 feet wide by 100 Including its underwater portions, even g will contain a total of over 200 million ̓5 million long tons) of ice.

e almost as dangerous to ships as rocks e size would be. In some respects they are dangerous because they move about and so :harted or marked by aids to navigation to m to be avoided. The bergs are slightly eenish in color on cloudy days and when in ; but in bright sunlight they appear a daz- . A number of bergs have dark blue veins id ice running through them, probably old /asses in which running water has frozen. ; have their cutting tools—dirt, gravel, and embedded in them. These they gradually sea bottom as they melt.

of their origin from an accumulation of snow, the bergs always consist of perfectly This ice is hard and brittle, much like the ice on ice cube. It is only when under heavy at ice will flow. Except for the solid blue ioned above, all berg ice is fillled with tiny , but these bubbles are not large or numer- 1 to greatly lower the density of the ice. as in the case of an ice cube in a glass of about one-seventh or one-eighth of each is above the sea surface, while about six- seven-eighths is submerged. The actual s depend on the slightly varying density of ater and the ice.

rgs have underwater spurs running out 50 e that are dangerous to ships, though most cliffy sides with no large underwater spurs ged extensive ledges. Since they normally in the usually rough or surging water of the than in the air, or in the colder water vn, they tend, at least when not surrounded ection of pack ice, to undercut around their The overhanging masses of ice then keep off and dropping to form small icebergs. ll icebergs are called growlers because of the sea makes as it washes against them.

wlers float entirely in the surface layers of 1ich are effectively influenced by the wind. on most days they tend to drift off to leeward from their mother berg. The breaking off or calving, as it is called, of growlers tends to keep bergs precipitous so long as they are in stable equilibrium. When bergs become unstable, they frequently list heavily and may even roll over and over as they melt, keeping in view rounded contours that were formerly parts of the underwater body of the berg.

From the time bergs are waterborne along the Greenland coast, they are continually breaking up and melting, but at varying rates. Until late in the spring, winter-chilled sea water of 29° or 30° F. is not uncommon at the surface in the colder areas. Such water does not turn to ice when chilled in the fall to 32° F. because of its salt content. When in this cold water, and when surrounded by the extensive pack ice of the north, bergs disintegrate slowly. They are then in cold storage, as it were, and under these conditions can actually last several years if they are large to start with. The pack ice preserves bergs because of the effective way it prevents waves from forming and because it keeps the sun from warming the surface layers to any extent, even in summer, until it has first been completely melted.

Because of their great mass and chunky forms, bergs survive longer than the pack ice and so can reach lower latitudes in the southward-flowing Labrador current. Therefore, the southernmost ice, with which the ice patrol vessels must stay fairly close, consists almost exclusively of bergs and growlers. In fact, the regular ice patrol vessels seldom get far enough north to sight the southernmost limits of the pack ice.

One reason why some of the bergs from the west coast of Greenland reach low latitudes each spring is because "what goes up must come down." The enormous volume of warm salt water that the Gulf Stream carries into the Arctic Ocean past Iceland and Norway, like the circulation of an enormous natural hot water heating system, must get back to the tropics whence it started, thus closing the circuit. Most of it probably finds its way back by means of a slow, cold, bottom creep, but each spring some of the icy Arctic water which is constantly fresher than Gulf Stream water augmented by the discharge of the northern rivers and glaciers and by precipitation at sea in the cold regions of little evaporation, makes a strong bid to get south in the upper layers of the western North Atlantic Ocean. The Labrador current, assisted by the strong west, northwest, and north winds blowing off the land or along the coasts, strengthens and pushes southward along the eastern edge of the Grand Banks. It flows past the tail of the Grand Banks in

43° N., 50° W., and plunges head-on into the flank of the Gulf Stream. Then a mighty battle of the currents takes place. Tongues of icy water push now westward, now southward and now eastward—far into the warm Gulf Stream.

Enormous eddies and swirls and fast local currents, which may run in any direction, develop. There is a mixing of the waters along the surfaces of contact between the Labrador and Gulf Stream. Sometimes cold tongues of the fresher arctic waters are able to push southward many miles under the warm salt waters from the southwest. Sometimes they overrun the warm water. Over the cold water, except when the cold clearing winds from the northward are blowing, hangs the Grand Banks' fog like the smoke of battle.

Eventually the advance from the north is always halted and the Labrador current always weakens. By midsummer the Gulf Stream, aided by sun-warmed surface waters and gentler winds in the north, stems the assault and pushes back the cold waters like the allies beginning to reduce the Belgian Bulge. Before this supremacy of warmth can be achieved, however, the cold current will have carried much pack ice and average number of about 420 bergs past Newfoundland and south of the 48th parallel. In some exceptional years only about a dozen bergs are carried south of 48° N., while in other equally exceptional heavy ice years over 1,200 cross the northern limit of special interest to the ice parallel.

The above figures indicate that the bergs are 100 times more numerous in the ice patrol area some springs than others. If this seems strange, remember that 48° N. marks almost the beginning of the end of the cold stream. You would normally expect the last stages of a river running into and disappearing in a desert to flow in farther and stronger some years than others and to carry more debris with.

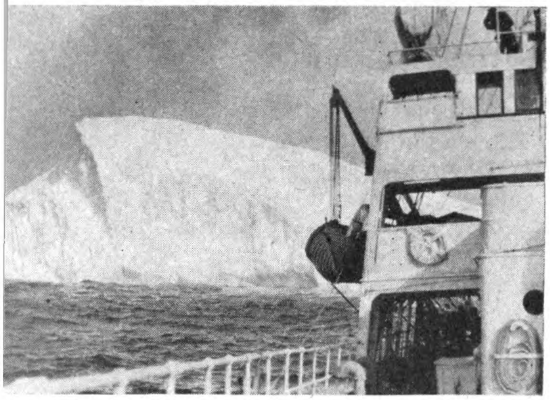
The 420 bergs of a normal year represent only the survivors of the tens of thousands that started out from west Greenland. The great majority always melt north of 48° N. Some never leave Greenland waters, some fall out in Baffin Bay. Many strand or melt along the east coast of Baffin Island. Still more meet the same fate off Labrador and Newfoundland. When there is little pack ice, the bergs tend to drift into shoal water and strand. In heavy pack ice years the flat ice acts like a fender, keeping the bergs to the eastward in deep water where the south flowing current is swiftest. If the bergs get too far to the eastward, they get out of the strength of the current and into warmer water and melt. Just as with us in the States, s year conditions of weather and ice in the no different. The scientific studies connected w ice patrol have led to a comprehension of the of many of the variables.

Of course, many factors enter into the vast lem of the war of the waters east and south Grand Banks. Every year the battle has pr unique one. Sometimes the cold water and ic strongly south, close to the coast of Newfour In other years they press down a little farther ea and the bergs are deployed over the compar slack and shoal waters of the Grand Banks. again, and usually, the cold stream carries mu rapidly southward along the eastern edge of the Banks. Sometimes the push of a curving branc the Gulf Stream moves in from the southeastwa is able to pinch off against the Grand Banks m the cold water near 45° N. 49° W., and thus stav considerable part of the further advance of ice ward beyond that point. At other times the wide open along the eastern edge of the Grand and the bergs are carried down across the sou most steamer tracks in the area, going to the 40 occasionally even to the 39th parallel of latitu latitude of Baltimore and Washington.

Practically all the bergs that get far south North Atlantic do so in the spring and early su In late summer and in the fall, even should the dor current be running at full tilt, which is rar case, the bergs would melt before they could low latitudes. The summer warming of all the ern waters usually melts the pack ice and most bergs back to the higher latitudes each year, a spring before the winter chilling of the wate the preserving action of the pack ice enable th current to carry the largest and most resistan down into the Gulf Stream.

The usual life of even a large berg in Gulf S or in any other water over 50° F. in temperat comparatively short. The ice patrol vessels hav by and followed closely the drift of many of the ernmost bergs and found that it is exceptional fo the large ones to last more than 10 or 12 days such conditions. Still, bergs can drift a goo tance in 10 days if they get into the strongest p the currents. They often move southward alo eastern edge of the Grand Banks 24 to 36 sea mi day. When they get in the swirls or eddies northern edge of the Gulf Stream, well authen drifts to the south, southeast, east, northeast, or

g 72 sea miles per day have been observed. ıme time, a berg some 50 miles or less away, nter of the swirl, may remain practically sta- ay after day.



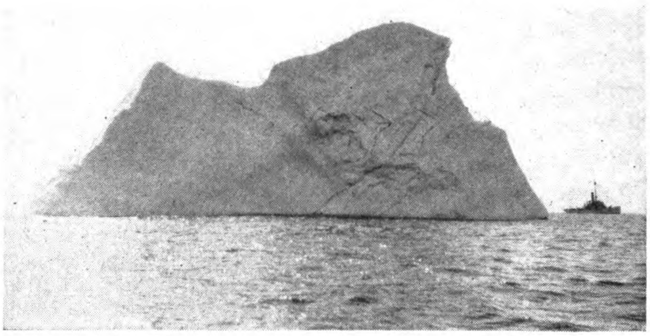
from the bridge of an ice patrol vessel as it watches throes of a southernmost berg which is fast melting o longer dangerous to shipping.

since vessels began crossing the North At- ıst the vicinity of the Grand Banks, they have contend each spring and summer with the ɔf colliding with the southernmost bergs dur- darkness and times of low visibility. During and good visibility there is no danger of col- ith bergs because they can be seen and avoided y as islands and rocks. The navigator has the ıssurance, in the case of bergs and growlers, that no submerged ice more than a few yards from He can cruise in and out among them in per- ty so long as he can see them and so long as them a reasonable wide berth.

rst North Atlantic lane routes established after ldle of the last century were effective in reduc- ısions between west-bound and east-bound ves- use they separated the traffic into two streams, raffic is separated on dual-lane superhighways, early tracks were not laid far enough south to e ice menace. During the period March 19, April 16, 1890, 14 vessels were lost and 40 damaged in the North Atlantic due to ice. these were many trans-Atlantic steamers that ided with bergs. The list would undoubtedly n longer if reports had been received of all ng and whaling vessels lost or damaged.

der to give some protection from this ice for a number of years prior to and succeeding : United States Hydrographic Office collected ice reports from ships and shore stations. It did its utmost throughout the ice season, with the means then available, to disseminate promptly to all ships the latest information relating to the constantly shifting limits of pack ice and bergs. For the United States to Europe tracks, the most dangerous season generally runs from March to July. Some years it starts early and ends early, in others it starts late and ends late. In some years it is 1 or 2 months longer than in others. Ice is always a threat along some of the Canada to Europe tracks, and pack ice blocks the northernmost ones completely for several months each year.

Up to 1912 there was no patrol in the ice region, the reports of passing ships and of shore stations being the sole dependence of the United States Hydro-



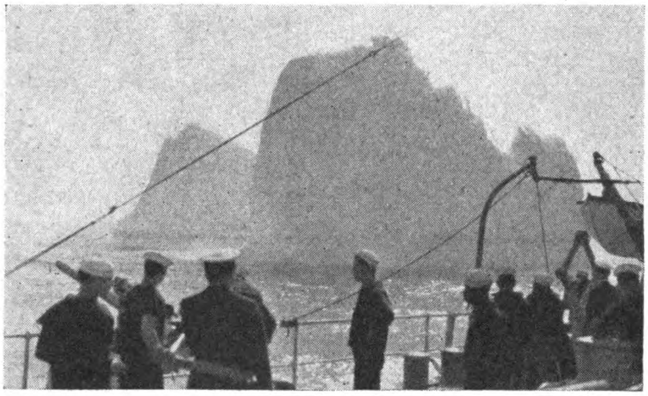
▲*A 240-foot Coast Guard cutter guarding an oversize berg near the steamship lanes. The black streaks running through the berg are dirt.*

graphic Office and other interested agencies for their ice information. On April 14, 1912, the *Titanic,* westward bound on her maiden voyage to the United States, struck a berg on a clear, calm night when some 75 miles south of the tail of the Grand Banks. She ripped a long gash along one side below the waterline and sank in about 2 hours with the loss of over 1,500 persons. A shocked public opinion demanded the immediate establishment of additional safeguards to prevent, if possible, the repetition of a similar disaster. Accordingly a continuous patrol was established during the berg season to keep track of and close watch on the ice threatening the trans-Atlantic steamship lanes and to warn, by radio, the vessels approaching the ice areas.

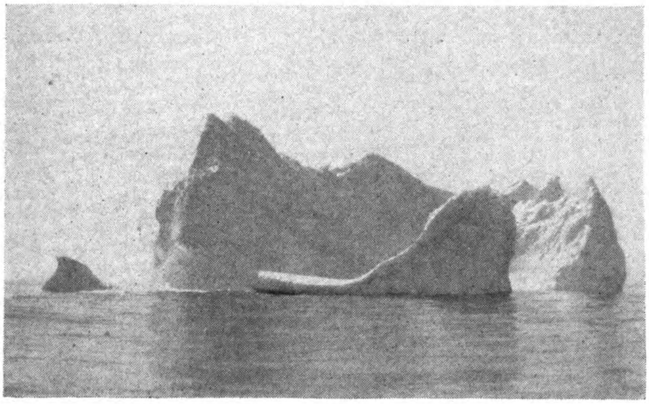
The United States Navy undertook the task, assigning two of its scout cruisers to maintain a continuous patrol during the latter part of the 1912 ice season.

From 1913 on, the ice observation and patrol work has been done by the Coast Guard. Each year, except during the World War years previously mentioned, one of the largest and most modern cutters of the

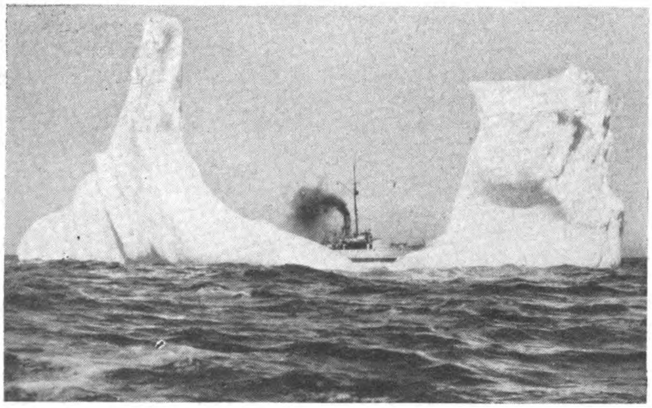
▼ *Getting a six-pounder ready to fire at a floating drydock type of berg which has two tall, thin walls joined together underwater. Such bergs are common around the southern part of the Grand Banks.*



▼ *A pinnacled berg with two offlying spurs that partly enclose a bay like formation into and out of which the swell surges.*



▼ *Ice patrol vessel passing behind a drydock type iceberg. Instances have been recorded of vessels actually drydocking themselves by running up on the underwater ice connecting the high points of these bergs.*



time has stood a continuous guard over the sou most ice each spring until it no longer threaten steamer lanes south of or crossing the Grand I Two cutters are used for the regular ice patrol They generally base at Halifax, Nova Scotia., be that is the nearest port to the patrol area that ha quate port facilities. The vessels alternate on p of about two weeks duration each. As their require that they relieve each other in the vicin the southernmost ice, this results in a schedu about 20 days at sea and 10 days in port each m Since 1928, a third vessel, usually a small, s Coast Guard 125-foot patrol boat has frequently used to make current maps of the critical porti the Laborador current, and to make post-seaso observation and oceanographic cruises into the v farther north.

The full cost of the maintenance of the patro sels during the ice season has been distributed a more than a dozen maritime nations that are interested in North Atlantic shipping. Theoreti each interested government contributes in prop to the tonnage of its merchant fleet benefiting the service.

The ice patrol in the western North Atlant the distinction of being a pioneer in internation tivities. That it has been a successful and ben one is obvious to all who are really familiar w This international patrol has steadily develop effectiveness through the years and has made in able contributions to the world's scientific know

The work of the International Ice Patrol c divided into two related categories: practica scientific. Since the practical work is paramoun first object of the scientific studies has been to p the practical work to be conducted more intelli and efficiently.

Let us first consider in detail the important fe of the practical work. The patrol, as it has been stituted, is not especially concerned with the pa which each spring drifts about in, and moves out the Gulf of St. Lawrence; or with the pack and ice in the Strait of Belle Isle or along the Cana Europe tracks northeast of that strait. That the primary concern of the Canadian Governmen they alone have patrolled or watched its limit character each year insofar as possible. They no maintain patrol vessels in the Gulf of St. Lawrenc ing critical pack ice times but they, like the Int

Ice Patrol, disseminate ice reports by radio from and shore stations and detailed ice information io to ships needing it. Ice in this gulf is usually etely melted about the time when the bergs are ıing to threaten the United States to Europe most seriously.

International Ice Patrol is, of course, interested conditions in the Canadian sphere to the north est of its particular area and so it often includes own broadcasts information about ice there, par-ly those relating to the ice along the tracks g through the Strait of Belle Isle. These tracks rmally completely blocked by pack ice for sev-nonths each year. They lie so far north off dor that even in the late summer months and the fall and early winter they may have bergs them. They are used when practicable because re closest to the great circle course from the St. nce to much of Europe, and so are considerably r than the tracks passing Newfoundland across rand Banks.

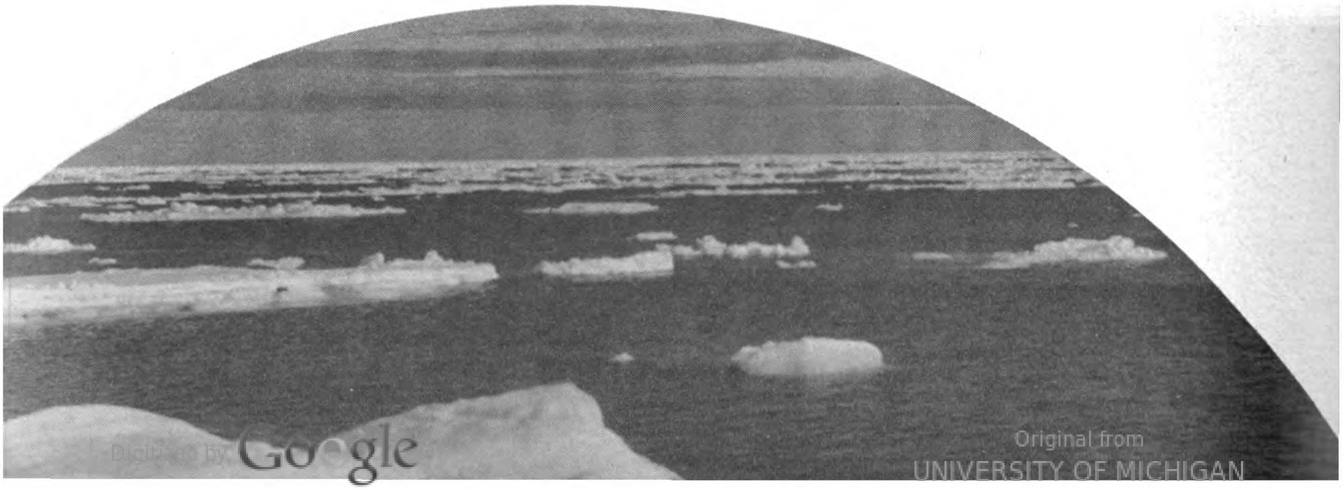
region which comes under the particular scru-f the International Ice Patrol, and which will ter be called the ice patrol area, lies between les 39° N. to 49° N. and longtitudes 42° W. to . Only a part of this large area of over 400,000 sea miles ever has ice in it because much of it ered with Gulf Stream waters that are always e.

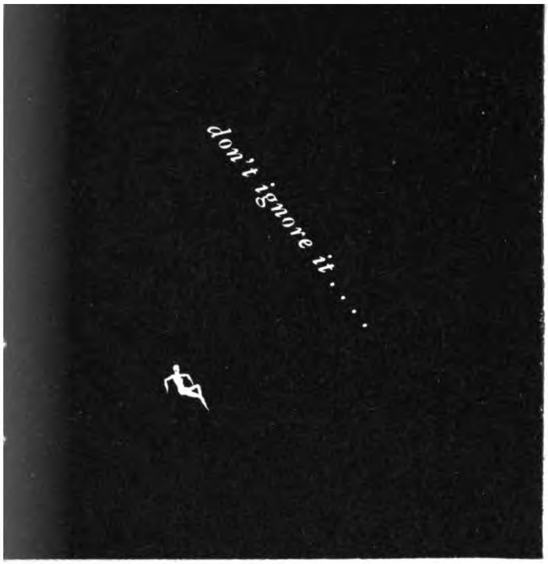
ice patrol, nevertheless, requests all ships to n position, surface water temperature, weather e reports every 4 hours while crossing the ice-area. The surface water temperature reports otted on charts on which curves are drawn which diately show considerable information regard-e southern limits of the Labrador current. This tes to the patrol about where it must search for uthernmost bergs, and shows roughly which way ported bergs will drift.

The patrol's first duty is to keep track of the drift of such of the bergs as are threatening the United States to Europe tracks, leaving them briefly from time to time to search critical areas through which cooperating ships have not recently passed, but always returning to and guarding the southernmost bergs, much like the Nantucket lightship marks the southern limits of Nantucket Shoals.

The ice patrol area has six pairs of steamship tracks crossing it. The three southernmost called the A, B, and C tracks are used by traffic between the United States and Europe, while the D, E, and F tracks are used by all vessels plying between Canada and Europe when the Straits of Belle Isle are blocked by ice. The reason for having two groups of three tracks each south of Newfoundland is to permit the shifting of traffic each spring to more southerly lanes when ice appears on, or threatens, more northerly ones. As the ice menace grows less with the advance of summer, the tracks are again shifted by steps to the shorter tracks farther north.

Of course there is normally much more ice on the Canadian tracks than on those to and from the United States. That does not necessarily mean that the former are correspondingly more dangerous than the latter. On the northerly tracks the masters of vessels expect ice and are familiar with it. They are usually extremely cautious, barely creeping along through the probable ice area during times of bad visibility and darkness. The vessels do not stay blindly on the tracks, but detour to the south as necessary in order to keep out of heavy pack ice. On the other hand, on the United States tracks, pack ice is almost never encountered and there are never more than a few bergs; in fact there are usually none. For these reasons traffic moves along at a much faster clip. It should be remembered that the *Titanic* struck a berg in the latitude of the southernmost tracks through the ice patrol area.





explore it!

IF search and rescue could plan, staff, and execute without dependence upon any other agency, it would have its own planes and ships, its own network of communications; it might even have its own separate training department, which in turn might produce motion pictures and other training aids peculiar to its own requirements.

However, it was not created in that concept, and it probably will never reach it. Participation by other branches of the Government and by private industry provides a wider field of interest and utilization of existant services without expensive duplication. Every house in town does not have to maintain a firetruck, if the town fathers have provided one that is instantly available. But there must be close cooperation with the water and power departments and street maintenance and a dozen or so others, if the emergency of a fire on your street is to be acted upon instantly and successfully. If the street commissioner, for instance, has authorized the roping-off of your block in order to hold a dance there, complications might result.

In the same manner, cooperation between all concerned must be present in every way, if search and rescue is to function efficiently at all times, and if a program of operation and training is to be successful. Such a program will require considerable time to set up, after existing and future demands are planned. In the meantime, as the residue of research conducted by many military and civilian sources during the war, there exists a large amount of material related to search and rescue. How best to discover and utilize this material is important to the immediate progression of any plans in this field.

Mention was made in last month's magazine of experiments with the Expendable Radio Sonobuoy (ERSB) in adapting it from wartime use to s and rescue. Development and testing of this d has been carried on under supervision of the s school of ComTraComWest at San Diego. Wh became apparent that training films would be n sary for aircraft, surface and subsurface crews, an survivors, in order to teach proper use of the e ment, the office of the Deputy Chief of Naval O tions originated a request for such motion picture

Such requests are submitted first to a Prio Board of the Navy, which approves or rejects o basis of need and utilization. From there the appı request goes to the Training Film and Motion Pi Branch of the Bureau of Aeronautics, Photogra Division, which is charged with the responsibilit production of all training and indoctrination film the Navy, Coast Guard, and Marines. Technica visers furnished by the Requesting Authority are ized in assuring technical accuracy in the pict This centralization of motion picture productic the TR & MP Branch provides both production distribution and assures proper standards. It avoids duplication of effort and unnecessary exp ture of funds by the various services and bureau

Determination of an existing need for a motion ture is the first step in obtaining it. However, co eration should be given to its place in an existing gram or a projected one, and this in turn require ordination with an over-all search and rescue prog An example of this would be the Sonobuoy pic mentioned above or a project launched by the Ca flage Section of the Bureau of Aeronautics, "V Range of Emergency Signaling Equipment," for time use.

Tests were conducted off San Juan to determin

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range of certain types of signaling equipment, otion pictures in color were shot of the tests. pictures were shot for the record and for later s of the tests. However, they also constitute ic footage for a motion picture on the subject tribution to personnel engaged in search and

They demonstrate actual *visual* results which studied by the audience, under the conditions tests which were made at varying angles to the d under varying light conditions at varying dis- In short, a "photographic report" was made, n be utilized to *show* personnel the range of y—a vastly more important factor than merely them through a printed report on the tests.

use there is a close relation to search and rescue e tests, the Bureau of Aeronautics, Camouflage , will request that a motion picture be made subject, utilizing footage shot during the tests. s utilization of wartime material for the best s of search and rescue in the international field peace time.

re must be a considerable body of similar ma- existing among the Allied Nations which can pted in like manner to build up the needs of and rescue. The criteria should be its appli- to the known or anticipated problems of search scue. Open sea seaplane landings and takeoffs ested near San Diego to contribute to known ation on the factors involved. While these be used for military personnel during the war, pplication to both military and civilian pilots ous. The release and distribution of such a to the personnel of all nations engaged in and rescue would appear important.

motion-picture camera recorded millions of feet of film all over the world during the war. Even if the immediate problems for which the pictures were shot no longer exist, there may still be a direct application of the footage to search and rescue. The safety of human life is the stake, and a great deal of effort must still be expended before all safety factors are covered. Somewhere there may exist a thousand feet of motion picture film which will of itself, or as a basis for an extended film, contribute greatly to knowledge of search and rescue. Not just our country, but all countries, require every scrap of information that can be made available. The military services should think continuously of the relation of motion picture footage to search and rescue, and should take steps to make it available as quickly as such a relationship can be determined. The byproducts often offer utilization as great as the original product, and this is particularly true when the necessity for the original no longer exists.

Do not just ignore the work of the past as finished business—explore it for possible application to the future of search and rescue. Approach the problem from the *visual* rather than *audible* point of view. When the real estate agent gets through describing the house he wants to sell you, your immediate reaction is: "Let's go *see* it." The procedure involved in teaching pilots the part an Ocean Station Vessel plays in ditching could be described in lectures and pamphlets, but *show* the operation itself in a motion picture and the pilot-audience have *vicariously experienced* it. It is this visible approach to search and rescue problems that demands utilization of every foot of film that can be made available. Do you have such motion picture footage that might aid in protecting a great many lives?

ort Subjects

-RAFT STORAGE

ncreasing surplus of pneumatic life rafts accentuates ortance of proper storage. If possible, life rafts not hould be unfolded and stored away from light in a ean location. Do not store rafts in a damp place, as ss causes mildew and deterioration. Unfolded rafts not be stacked more than 15 deep. If storage facili- limited, rafts may be stored in carrying case.

should not be stored around grease or oil, which are ous to rubber. Wet rafts should be unfolded and oroughly before packing or storing. Those showing se, oil, or mildew should be washed immediately with vater, rinsed and dried. TO 119–44 provides for semiannual inspection of all life rafts in stores to check deterioration.

GOING UP

Statistics from commercial air lines for 1945 show a startling increase in civilian travel. For example:

Chicago & Southern—in October 1945—approximately 10,000 more revenue passengers than October 1944.

Colonial—up 4,000 over October 1944—first year in history traffic did not decline in October.

Continental Air Lines—increase of 113 percent in passenger traffic first 9 months of 1945.

Delta Air Lines—over 9,000 increase in October 1945 over October 1944.

Northeast Airlines—carried more passengers in October than in any single month in its history.

United Air Lines—reached a new high of daily flying miles of 131,000 recently. The high daily figure prewar was 82,000 miles.

navigators form socie

ALIVE to the need for a common meeting ground, a clearing house where all concerned in navigation—air and sea—might speak together professionally, and collectively insure navigation progress, a small group in Washington on 27–28 February 1945 issued a call for a meeting to found a society of navigators.

The founders' meeting was held in Los Angeles on 25–26 June 1945. Leading air navigators and representatives of this new professional group from the Army, Navy, Government Bureaus, air lines, aircraft and instrument manufacturers, colleges, universities, and astronomical observatories were present. At this meeting the organization was incorporated as the Institute of Navigation.*

The second meeting of this organization was held in New York on 25–26 October 1945, when the 21 members of the council were elected. They include:

Colonel Fitzgerald, Major Deavers and Capt. Wendell of the Army, Capt. Weems, Commanders Patterson and Catlett and Lieut. Comdr. Williams of U. S. Navy, Comdr. Wild, U. S. C. G., and Messrs. McIntosh, Mixter, Clemence, French, Wylie, Stewart, Gatty, McClure, Smilie, Burka, Rattray, Mattingly, and Baldwin. These men in turn elected the following officers:

PRESIDENT—Colin H. McIntosh, American Airlines.

VICE PRESIDENTS—Major Trevor Hay, Wright Field; Major James H. Hall, Randolph Field; G. A. Atwater, Hayden Planetarium, New York; Walter Hadel, National Air Lines.

SECRETARY—Samuel Herrick, University of California.

TREASURER—P. E. Wylie, University of California.

COMMITTEES

FINANCE—C. T. French, Fairchild Camera and Instrument Corp.

PUBLICITY—Capt. P. V. H. Weems, United States Navy.

MEMBERSHIP—Comdr. F. G. Wild, United States Coast Guard.

*Application blank may be obtained from chairman, Membership Committee, Institute of Navigation, 1911 Eye St., NW., Washington, D. C.

The Institute membership includes a varied gı many of whom are professional navigators wh been flying the ocean for the various air as contact carriers for the Army (ATC) and (NATS). Due to the interest created by this of air-line navigators, the emphasis and Institı tention is concentrated on aerial navigation, but is now under way to interest surface navigaı well.

In addition, the educational interests are well sented by various members of the collegiate te fraternity and by astronomical societies. Serv terest has also been solicited and Army and personnel have responded.

A synopsis of the opinions expressed by sp at the various conferences emphasized that navigation is a combination of many known syst dead reckoning, radio, celestial, loran, altimc pressure pattern flying and the application of n ology or aerology to completion of a successful The Institute pledges itself to the advancem these various ideas in publishing pertinent sci papers and conducting experiements wh practicable.

With World War II, a century of scientific pı in the ancient art of navigation was telescoped few brief years. Industry in the field of radic tronic and optical instruments, through researc given the navigator precision tools that challen imagination. Strides, too, have been made laboratories of the universities, in classroom cur in the scientific contributions of meteorologis astronomers. Yet, unlike other professions, navi has had no organization whereby the many ı institutions, and agencies could meet in open for

It was with this idea in mind that the Instiı Navigation was founded. Its purpose is to insu further the tremendous advances made in the s of navigation during the war. Air navigators Army, Navy, and air lines, and others concerne the research, production, and education in the f navigation, have joined forces and talents to emı the need for safe and efficient navigation.

The following material, like "Gasoline as a Fire Hazard," which appeared in the February bulletin, has been extracted from the War Department's TM 5–316. It is believed the whole general subject of crash fires and how to fight them is of vital concern to all personnel either directly or indirectly engaged in search and rescue activity. While the material from TM 5–316 deals primarily with plane crashes on land, the basic principles apply to crashes on water as well. Ed.

shfires

OPERATIONS

: operations are the primary objective in : fighting. The successful removal of air crew every necessary speed and teamwork. Prepa- hould be so complete that they may be started at a truck rolls into its approach position.

· normal circumstances two rescue men should 'or operations at any single point of attempted The following outline is principally based on of two men at a single point. If other points are selected a repetition of the procedure out- l apply to additional rescue teams.

ESTIMATE OF AIR CREW IN AIRCRAFT

Escaped air crewmen may give a clue as to the number believed remaining in the plane. If the aircraft involved is a transport or bomber a check on the total crew and passengers may be impossible within reasonable time limit. If more than a very few passengers or crew appear to be involved and unless there is absolute and unquestioned assurance of their safety outside of the aircraft, no dependence should be placed upon appearances that all aircrew are out. Investigations must be carried out to guarantee clearance of personnel from a burning airplane.

POINT OF ATTACK

Only a general outline can be made on the method of attack. The principal points of concern will be the probable locations of trapped air personnel, the location of the fire, its possible envelopment of additional parts of the airplane and the location of access doors or points of forcible entry. These will be affected by gun positions, presence of bombs, incendiaries, flares, and location and quantity of other fire-fighting equipment. The most suitable point of entry should be chosen from a full consideration of all the circumstances. A typical exit diagram on a four-engine airplane is shown in figures 6–2.

APPROACH TO AIRPLANE

If high pressure turret streams from the class 155 crash fire truck or CO_2 from the class 150 crash fire truck are being used, almost immediate approach to the aircraft may be possible. Rescue men should take the path cleared, if high pressure turret water blast is used.

Great caution should be observed in attempting to enter planes which are surrounded with intense, widespread fires. Backflashes may cut off the rescue men within the flaming area.

MOVEMENT OF WRECKAGE

No part of the airplane structure should be moved unless it is absolutely essential to rescue operations. If any fracturing of structure has occurred, electric cables may have been broken. If the main switch has not been cut off, cables may still be connected to the battery. The slightest movement of wreckage or fragments may cause a broken cable to spark sufficiently to ignite gasoline vapors which have drifted to that point, regardless of its apparent remoteness from any visible gasoline source. Static electric discharges may be caused by slight movements of parts of planes. Figure 6–3 shows a typical crash in which movement of wreckage would be hazardous under usual circumstances.

In spite of the general hazards of moving parts of aircraft, circumstances exist in which such risks are warranted. Airplanes may be partially moved to a more favorable angle with reference to the wind. They may be moved to protect trapped crew by changing direction of progress of the fire. Where large parts of the fuselage have been separated by impact and where only isolated parts are involed in a general fire, it may be possible by the use of grapnels or cables to remove a portion of the aircraft to a point at which the danger of ignition is reduced. Small aircraft may be pulled away from gasoline spills or saturated gr

Airplanes are occasionally found resting in position on their backs. Single-engine aircraft covered cockpits may have the canopy or access partially buried. On some types of soils it m safer to dig under the inverted cockpit to release t crew than to attempt to move the fuselage.

ACCESS DOOR ENTRY

The easiest and quickest way for rescue men tc access to the airplane is by the use of doors and e hatches.

In most instances these are provided with ext releases. The exterior latch of either the hanc flush type may be quickly operated. If heavy asl gloves are worn over leather gloves, it may requi use of a screwdriver or bar to operate the flush latch.

If there is no exterior release device, shatter a dow to reach interior release.

If a door is jammed, attempt to force it aroun framework or at the hinges. Bring a bar or han to bear if the damaged unit can be displacec doors or hatches are immovable a plastic or glass may be the next fastest means of entry.

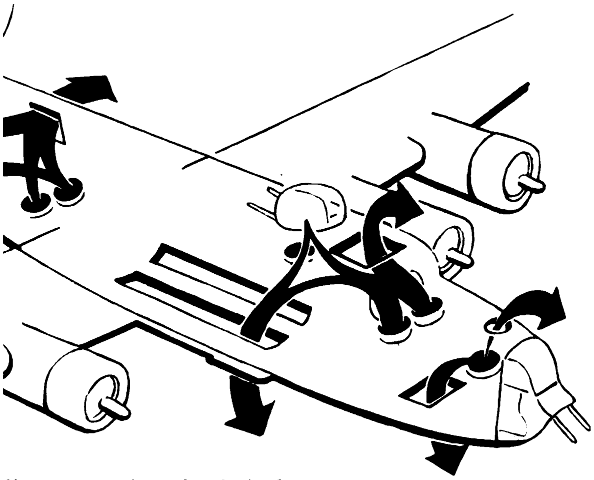
The forcing of jammed doors and escape ha should be tried before an attempt is made to ente airplane otherwise, unless glass or plexiglas ope will serve. The reason for this is that such opc are not ordinarily obstructed by equipment insid airplane.

PLEXIGLAS

Plexiglas is readily shattered by a sharp blow a hand axe. Broken sections will separate anc away from any part remaining within the frame A large area can be completely and swiftly opene by quick, repeated blows.

SAFETY GLASS

Safety glass, consisting of two or more glass l with one or more plastic film interlayers, may be tered with an axe. Its complete removal is sl than plexiglas. The shattering occurs principally radial lines from the point of impact, as with inated glass in automobiles. Relatively small ments or slivers will fall away from both the inne outer glass surfaces near the point of impact, bu majority of fragments remain held in place by center of soft, flexible plastic film. After se blows, the plastic film tends to hold the sagging ments together, in spite of the destruction of the i



liagram on 4-engined airplane.

ıter layers of thicker glass. Continued blows t through the plastic film and the section of ed glass will collapse.

OW FRAMES OR BAYS

iglas or safety glass sections are fastened into elage framework by metal strips. Rubber or ition inserts cushion the actual contact around of the transparent section. If glass is cracked ır the edge, the cushion strip may be reached ipped from the slot. This releases the trans- section and leaves no jagged, cutting fragments frame.

ctions of glass or plexiglas are used to form hey may be supported by metal framework. knocking out two adjoining panes, the metal work may be separated from the fuselage at top om by a heavy blow or by sawing with a hack al saw. The metal framework may then be outward. This will leave the total space of insparent sections open.

omparison of rapidity of entry, breaking trans- sections may require more time than removing jammed doors, but will require less time than through metal skin, transverse frames, and rs of a fuselage wall.

LAGE WALL ENTRY

failure to gain access through doors, hatches, gs, plexiglas, or safety glass, entry must be at- d through the wall of the fuselage itself. A te mental picture should be set up of the inte- angement of bulkheads, partitions, decks, armor and fixed equipment. The approximate loca- the majority of cables, connections, and tubing e estimated. Taking these factors into con- ion, along with the most probable location of entrapped crew and the possibility of interior movement once entry has been effected, a section of the fuselage is selected for cutting.

SELECTION OF LINE OF CUT

Cuts must be made so as to involve the least possible number of reinforcing channels, stiffeners, ribs, or longerons. Structural reinforcements of skin surface are almost always parallel or perpendicular to the length of the fuselage. This creates rectangular sections of skin surface between horizontal stringers or longerons and curved vertical ribs or bulkheads.

The position of the internal reinforcements is indicated by the rivet heads exposed on the outer surface. A single line of rivets means that the interior reinforcement is probably a light channel. Two or more closely placed rows of rivets mean that either several lighter sections are adjacent, or that a heavier channel or built-up section of some magnitude is immediately underneath. Cuts must be laid out so as to avoid as many as possible of the closely positioned double rows of rivets.

The area desired will consist of one or more adjacent rectangular sheet skin surfaces which involve cutting the least number of heavier sections supporting it, and whose combined area is sufficient for access. The general outline of a typical section selected is shown in figures 6–4 and 6–5. The cut is indicated.

MAKE SMALLEST CUT POSSIBLE

Usually only three sides of a rectangular opening large enough to permit access will have to be fully cut. The fourth side may be used as a hinge and bent back. Cut any heavy sections along this side and use the still-joined skin surface as a hinge. If the opening is on the upper part of the fuselage, the top side should be used as a hinge and the cut section swung outward and upward, where it will not obstruct movement from the interior to the ground. If the opening is low on the fuselage, use the bottom side of the cut section as a hinge and swing it outward and downward. Any section cut should always be removed outward, so that it will not be within the fuselage to create an additional obstacle inside.

Water in the form of straight streams or fog may be constantly applied during the cutting operations to offset ignition of vapors or ruptured lines.

TUBING, WOOD, AND FABRIC FUSELAGE ENTRY

In tubular and fabric fuselage construction the fabric surfaces may be rapidly cut away with a knife.

Tubular sections of steel or Duralumin may be cut with a rotary pipe cutter, by a hacksaw, or by metal-cutting saw.

Entry through fuselage construction of plywood or moulded woods may be by wood saw or axe.

ENTRANCE INTO FUSELAGE

No more than one of the two rescue men in a rescue team should make an initial entry into an aircraft. The other rescue man should stay at the opening until some indication is given from the crewman inside as to necessary action. Signal should be given if help is needed inside or if the withdrawal of the inside crewman becomes necessary from some development apparent to the outside crewman.

ACTION WITHIN FUSELAGE

When an entry is made the first step is to locate personnel and determine conditions. Where immediate hazards are beyond control of rescue men, so that time is limited, remove air crew at once. In other cases it will be more practical to reduce hazards first and thereafter remove personnel.

In such circumstances, the master and gun safety switches should be checked in the "Off" position if they can be reached. Gasoline selector switches, booster, and transfer pumps should be cut off. Hazardous material should be removed or placed as far as possible from the fire. This includes pyrotechnics of all types, incendiaries, ammunition, and bombs. The first action on any gun is to elevate its muzzle. Immediate elevation of the gun muzzle will usually raise the line of fire above the crewmen on the ground. If time permits, ammunition belts may be removed and cartridges ejected.

RELEASE OF CREWS FROM BELTS AND HARNESS

Air crewmen may be held in their seats by safety belts and shoulder harness or parachute harness. The fastest removal from safety belt and shoulder harness is to operate the release catch itself, not cut the belts. If the air crewman is unconscious, the safety release catch in the middle of the belt across the stomach should be opened. This releases the safety belt; the shoulder harness straps will come free if they are jerked slightly.

When the safety catch cannot be reached, cut the webbing of the safety belt. If the safety catch on a belt cannot be released and shoulder harness is in position, each shoulder strap will have to be cut separately or the joined harness slipped over the head. A shoulder harness release lever at the base of the extends the straps from the seat back without pletely releasing them. The use of this lever allow sufficient movement to help in rem operations.

Parachute harness may have to be cut off befor crewman can be moved. This is done by cutting webbing straps. This will leave the parachute ir seat, removing possibility of parachute or harness from catching in debris during removal.

RELEASE OF AIR CREW FROM CONTR

The control stick or wheel and drum may ja such a position as to pin the pilot or co-pilot. It be faster to remove the cause of jamming than t tempt to move the stick itself. The stick is conne by cables to the control surfaces, rudder, eleva ailerons. Jamming of pulleys, pressure against cables in any part of the aircraft, or wreckage ag the control surfaces themselves will make the immovable. In such cases, cutting a cable or lin at any point between the jam and the control should release the stick. Cables or linkages to rudder and elevators may be exposed within the lage, those to the ailerons may be reached in wings through access plates, engine nacelles, lan gear compartments or removal of leading edges. are easily cut at any exposed point. Teamwor the operations of the two rescue men and knowl of the plane structure will play an important pa operations of this type.

RELEASE OF AIR CREW FROM DEBRIS

If members of the air crew are pinned by wrec or controls, their immediate release may not be sible. Their position should be communicated t fire fighters outside. Efforts should be made to the fire from reaching those areas by forming a w curtain around them, or by concentrating exting ment efforts around those points. Wire-cutting p hacksaw, bolt clippers, hand hatchet, and bars prove useful in confined operations to release sonnel. When limbs are entangled in cable, tubin fragments, extreme care must be exercised in re operations to avoid aggravation of injuries. U the emergency is extreme due to the physical cond of the air crewmen, or unless removal must be ma once due to fire or heat hazard, advice of me officers should be secured during extrication operat Patience and careful work may accomplish more less harmful results than an excited rapid effort.

N REMOVAL OF INJURED

ıe care must be taken in removing air-crew if they appear to be injured. Injuries may ly aggravated through inexperienced han- Compound fractures encountered in crash in- ıy be transformed into more serious or even uries unless removal is made in the proper When a fire is not serious or is under con- nediate removal by crash crew may not be if experienced and competent medical aid y at hand.

AL AID

rimary objective is to relieve air crew from to hazards accompanying the crash. All ac- st be taken so that additional injury is not Medical advice should be used whenever during removal of air crew. Preliminary t should be provided prior to transportation d from the site.

al assistance must be introduced at the earli- ɔle time.

CTIVE CLOTHING IN IGHTING

are general misconceptions on the use of e clothing for crash fire fighting. Crash ı, even in asbestos suits, cannot enter active fire areas, perform rescue or fire-fighting ıs over extended periods and walk unharmed flames.

tive clothing of some type has a place in e fighting, but its limitations must be recog- d anticipated.

RESISTANCE OF ASBESTOS SUITS

os cloth is not so much heat-defying as flame- t. It keeps flames from igniting the wearer's ɔthing. By its construction the asbestos suit ıe wearer's face and hands from heat. But it by itself have extraordinary insulative quali- worn without heavy clothing under it—the suit could not be depended upon for total ı of heat. Heat insulation must be provided ɔlen cloth lining to the suit itself or by separate othing worn by the individual: heavy shirts, rts, leather jackets, heavy trousers, boots, and ther gloves. Even with this supplemental in- direct exposure to intense heat is possible a relatively few seconds without burns.

asbestos suits are properly used their principal is to prevent ignition of clothing. This gives such temporary protection to its wearer, that if involved in unexpected flashbacks he is not immediately seriously burned or trapped. These few seconds additional resistance warn inexperienced men to withdraw from the extreme hazard which is threatening.

WEARING ASBESTOS SUITS

Current types of asbestos suits are one-piece or multiple-pieces which overlap. All fasteners must be secured carefully with flaps in position to prevent the entry of flame. Suits must be adjusted as nearly as possible to the wearer's body so that they are not baggy and restrictive to motion. Leather belts may be worn around the outside of the legs or body to confine the surplus material on oversizes. The amount of clothing required under suits can only be determined by an individual's reaction and experience. The helmet and hood of some models are awkward unless carefully adjusted. The headpiece must be fitted to the size of the head so that the eye openings and helmet will stay in position when the wearer is in motion. The eyepiece should be held away from the face by an inner helmet, or an insulating cap must be improvised. This should suspend the eyepiece forward so that, when heated, its edges will not come in contact with and burn the face.

Insulation for the hands and feet is necessary since these will come in contact with heated surfaces more closely than any other part of the body. Boots and heavy gloves must be worn within the asbestos gloves and shoes.

Asbestos material has a low cotton content and may char slightly. It is sometimes sewn with thread which may char and burn under continued direct exposure. The seams are usually sewn, folded, and sewn again to form a lock seam.

Extreme care must be taken to prevent liquid gasoline from getting on the suit. Many serious burns have been caused through subsequent ignition of the

liquid directly on and within the pores of the clothing.

Breathing is through the pores of the fabric itself unless special apparatus is used. The only precaution to be observed is the correct positioning of flaps and openings in the front and lower part of the hood and chest so that direct openings do not occur which will admit flaming gases. The loosely woven cloth, if properly adjusted, filters these out but does not guarantee the presence of breathable air.

DISADVANTAGES OF ASBESTOS SUITS

The disadvantage of asbestos suits is awkwardness in action, which is apparent in most suits in current use. Difficulty in motion and in complicated rescue operations is caused principally by poor fit, weight of water absorbed if wet, and the bulky clothing which must be worn under the suit itself for insulation. Recent models of asbestos suits are adjustable for better fitting in body and hood and have simplified closures. A secondary difficulty with asbestos suits is the time required to put them on.

ALTERNATES TO USE OF ASBESTOS SUITS

Protective clothing may consist of any materials not easily ignited, such as heavy leather boots, bunking trousers, coats, and leather gloves, together with a hood of any heat-resistant material. Some experienced crash fire fighters prefer to be clothed in regular

heavy clothing in order to gain greater freedom of action than is possible with asbestos. Men so clothed may be wet down, if required, in a method similar to that employed with asbestos suits. In crashes where complicated cutting and removal operations are necessary within confined areas, less bulky clothing permits more effective work.

The employment of asbestos-suit men for initial operation does not eliminate the use of more compactly clad rescue men as soon as the latter c effective. This may be accomplished by interc of position with hand-line men.

The most important thing is to decide wha tective clothing is most practical for local conc and to have rescue men trained in its use with knowledge of its limitations.

OPERATIONS IN PROTECTIVE CLOTI

Crewmen in protective clothing may perforr tasks dry or wet-down to remove heat by water oration.

In wet operation the continuous wetting or cu ing of crash crewmen in protective clothing is th commonly used method. It removes heat, by eva tion of water, and thus favors quick entry. subjects the wearer to risk of scalds if water st are not continuous. If unprotected in areas o extreme heat, steam is generated within the suit by the vaporization of inner moisture. This will or burn. Lastly, wet operation burdens the v with additional weight.

Dry operation is sometimes practicable. clothes are lighter, easier to work in. There danger from interior scalding, and dry operati quires no covering action by other crewmen. I advantages are that it may be difficult to kee wearer entirely dry and that there is no heat rer CO_2 may be used for cooling the body in dry tion. The use of CO_2 in mass discharges inc the possibilities of dry operation.

Foam, when accidently turned on rescue m hoods or when deliberately applied in lieu of for cooling purposes, should be kept from th pieces. It obscures vision and may completely p

(Continued on page 23)

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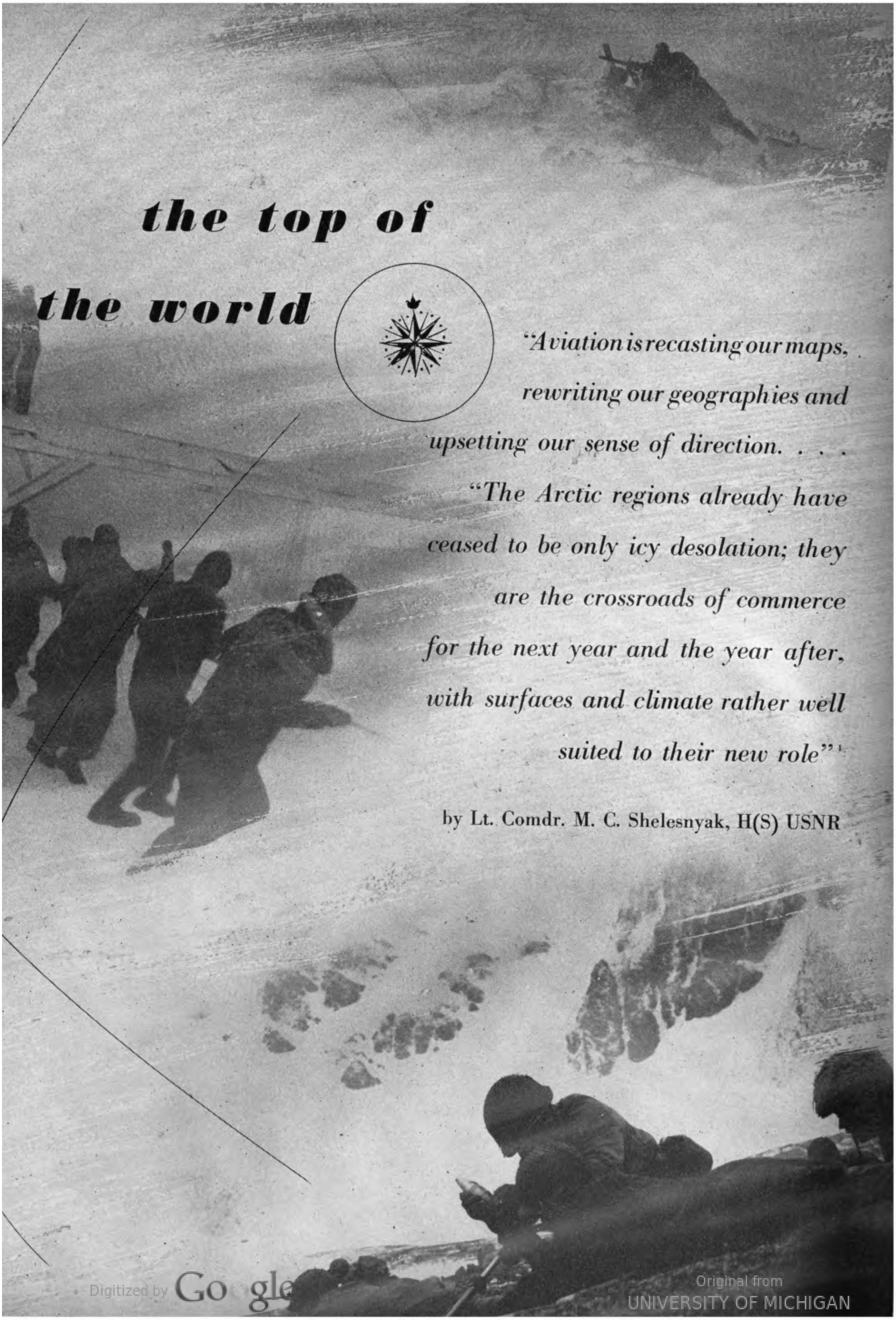


the top of the world

"Aviation is recasting our maps, rewriting our geographies and upsetting our sense of direction. . . .

"The Arctic regions already have ceased to be only icy desolation; they are the crossroads of commerce for the next year and the year after, with surfaces and climate rather well suited to their new role"[1]

by Lt. Comdr. M. C. Shelesnyak, H(S) USNR

part 2

Second in a series of two articles on the history, geography, and life in the Arctic.

Part I of this article, which appeared in the February issue of the BULLETIN, gave a fairly detailed description of Arctic geography and climate. With that as a background, part II presents some pertinent comments on plant and animal life in the Arctic, and sets forth the major problems incident to emergency survival and the cautions which must be observed to minimize them.

One of the many ancient but persistent misconceptions of life in the Arctic concerns its uninhabitability for plant and animal life. Yet it requires but little study and observation to prove that no matter how far north we go, plant and animal life do exist in comparative abundance.

Lichens, grasses, and shrubs are the predominant plants of the Arctic tundra, which is remarkably uniform in composition in spite of the extensive area of the Arctic regions. Well-watered slopes bordering the lakes and streams contain moderately luxuriant vegetation—many of the larger plants and shrubs reaching heights of 7 feet. Reindeer lichen and rock tripe lichens cover the rocky and sandy ridges. Swamp areas are extremely common and in them, and along the streams and lakes, will be found extensive growths of cotton grass. The meadows contain low shrubs, mosses, and lichens which, in the spring form a brilliant kaleidoscope of purple, blue, and yellow flowers.

As one moves southward into the sub-Arctic regions, a belt of mixed areas of forest and tundra appears, with strips of trees showing along the river valleys. Sub-Arctic forests are dense with white spruce, black spruce, tamarack, aspen, balsam, poplar, and paper birch. Scattered throughout are myriad bays and lakes thick with grasses, hedges, and sphagnum which become matted with cranberry, Labrador tea, leather leaf, and other shrubs; and eventually, black spruce, larch, and alder.

Animal life—polar bear, sea walrus, whale, fox, wolf—exists even on the polar ice cap. The polar bear lives on the ice pack and subsists almost exclusively on seal.

Several species of seal are to be found—some of them banking on the ice floes, others on sand bars and rocky islands in the summer months. The sea or large seal, breeds off the Aleutians and moves s ward in the winter. Large, thick-skinned walrus s times weigh as much as 3,000 pounds, and li clams.

There are many different species of whales. the Arctic waters are inhabited by the beluga, or whale. The beluga is a relatively small mar from 12 to 16 feet in length, which swims cl shore in schools of 12 to 20. They have even known to ascend the mouths of rivers. The head—or Greenland whale—is much larger a found in deeper waters.

Three species of bear—the Alaska brown grizzly, and the black bear—inhabit the sub-A forest. The Alaska bear, which lives only in c Alaska, has been known to weigh as much as pounds. The grizzly ranges the Arctic tundra black bear's habitat is generally limited to the w country though he has reached the mouth c Mackenzie.

The Arctic tundra is inhabited by caribou deer), moose, musk-ox, Arctic wolf, Arctic fox, r tain sheep (bighorn), mountain goat, Arctic ground squirrel, and the lemming. Migratory including geese, ducks, and swans, nest in large bers on the Arctic islands. Terms, gulls, loons, p dovekies, murres, snowyawls, guillemots, and A grouse are found throughout the north country.

Fish are extremely abundant in all Arctic an Arctic waters and constitute one of the main fo the natives. Salmon, cod, whitefish, flounder sculpins, herring, trout, pike, grayling, connies few. Sucker, tullibee, smelt, tomcod, and bul are others.

Insects, contrary to general belief, are nun during the summer months. There are not different kinds of insects but the mosquitoes (of 30 species exist), sand flies, bluebottles, and bc are overwhelming pests. Of mosquitoes Stefa writes:

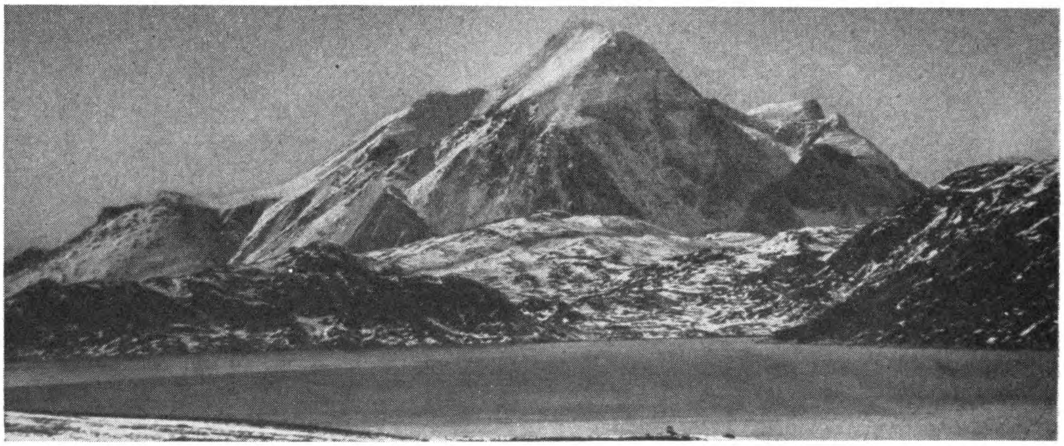
> On numerous occasions, he had to make repeated before he could get a sight on caribou with a rifle. He brush the mosquitoes from the front and rear sights; he could get a bead, there were insects on at least one sights and sometimes on both.

There are two reasons for the profusion of m toes, (1) the slight temperature variation betwee night and midday so that when warm weather s incubation conditions are ideal, and (2) the inc number of small lakes, swamps, and infinite p

of water which make for unlimited breeding

s the general aspects of the habitability of
: can best be summarized by a statement from
)epartment's Arctic Manual: [1]

:tic region is neither forbidding nor inhospitable. the exaggerated stories of some explorers, it has ı the minds of many people a wholly undeserved for unlivability. White men settled in the Arctic before the time of Columbus. And continuously last 275 years, resident managers of the Hudson's any have lived in contentment at permanent posts, vhich are in isolated places. As for the native attered evidence suggests that they may have made appearance in the North American Arctic as long or 25,000 B. C. At present, the Eskimos are per- oy without most of the articles that are considered ɔ civilized existence. These people are not an :e. Within the limits of their resources they have live in the Arctic more successfully than many ivilized peoples in less rigorous climates. Hun- vhite men—trappers, miners, and missionaries— their lifetimes there. They have learned to know to live comfortably in it, and to love it. To be anent settlement is small, but it has been limited



ch by climate as by lack of natural resources and communication with the rest of the world.

ıcts should not be interpreted to mean that any- ve anywhere in the north without forethought, endurance. The Arctic imposes its own natural regulations on its inhabitants, and the secret of living there lies in working *with* rather than :ure.

'ctic is cold, but the coldest spots in the world ı the Arctic; it is barren, but vegetation and ıammal, fish, bird, and insect life abound; it but chiefly in localized areas; it rains and avily, but only in spots; it is friendly, if you nd understand it. If you are willing to learn natives and experienced travelers, you can manage a relatively comfortable stay with your grounded plane, or walk out to safety.

It is interesting to read what Stefansson has written about the comparative safety of the seas in discussing the missing Soviet fliers, Levanevsky and crew, who were lost on 12–13 August 1931, while attempting a transpolar flight from Moscow to Fairbanks.

Levanevsky was assumed to have made a forced landing on the polar sea. Therefore, we consider the various oceans, how they compare for the safety of forced landings.

Most flyers who have come down on liquid seas far from land and beyond sight of a vessel have been lost. All have been lost who made forced descents beyond the sight of rescuers in a gale.

Before the Levanevsky flight there had been perhaps a dozen forced landings on the frozen sea. Some were in good weather, some in falling snow, some in blizzards, and one in a combination of gale and the darkness of night. All these had been safe descents—no lives had been lost and there had been only minor injuries to planes. The flyers were always saved in one of three ways: they made repairs and flew again; they were rescued, by plane or ship; or they abandoned their plane and walked ashore.

Take specifically for the North Atlantic the entire period from its first crossing by the United States Navy airplanes in 1919 to the beginning of survey flights by Pan-American Airways and Imperial Airways in 1937. During this period at least 19 ocean descents were made in all weathers from calm to gale. Nine planes were lost. The people saved were mostly those who had specially good luck, as coming dowin in fairly good weather either within sight of a ship or after being able to communicate to a nearby ship through radio the approximate position of their descent.

During the same period more than 90,000 miles were flown over the polar sea. There were at least 56 voluntary and forced descents in all weathers from calm to gale (not all Soviet figures are available). No lives were lost from any of these descents.

The safety of the polar sea, as compared with the deadliness of the North Atlantic, is the result of frost. If water is liquid, the best you can hope for is to swim awhile before sinking. When water is solid, you behave upon it as if it

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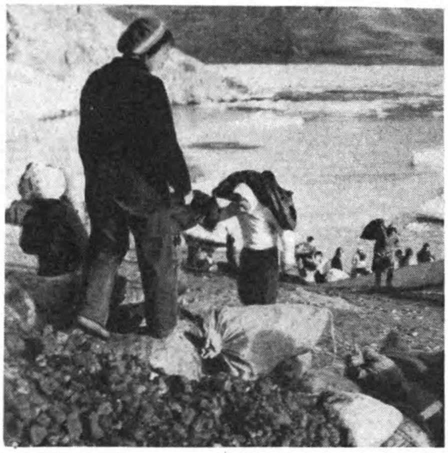
[1] cal Manual 1–240, War Department, 1945.

were land. You are warmer on the ice at —50° than you are in the water at 50°, for water gets to your skin but cold air is held at bay by your clothing. In a 50-mile storm on a liquid sea the waves break over your plane and toss it about until it sinks. In a 50-mile wind on the pack ice you can lash down your plane as if it were on land. Then you construct a windbreak of snow blocks and tent behind it. You can build a dwelling of snow in which, by Eskimo technique, you can have a warmth of 50° when the thermometer outside reads —50°. If your airplane is beyond repair, your radio may not be, and you have time and comfort for getting it into shape.

We focus the broad contrasts through special cases of the liquid and then of the frozen sea.

Captain Charles Kingsford-Smith, Australian, was first to make the east-west and west-east crossings of the Pacific. Then he took off from England on 6 November 1935, accompanied by Thomas Pethybridge, attempting to set a new speed record to Australia. They were last seen on 8 November fighting a monsoon off Siam. A search was immediately undertaken by four Royal Air Force flying boats and mail planes, but no trace of the missing fliers was found.

On 2 July 1937, Amelia Earhart, heroine of American aviation, and her assistant, the competent and experienced



navigator Fred Noonan, came down in the tropical Pacific. While not exactly a calm, there was no high sea running. No ship was right by, and the exact position was not known. The search, begun at once by private vessels, by the United States Coast Guard, and by the United States Navy, was abandoned after 10 days. The only hope remaining was that, perhaps far out of reckoning, the plane might have come down near a tropical island. We do not often say it, but we all know it—life is not possible for any length of time in the ocean of the tropics except upon such lands as you may reach.

Swinging from tropics to Arctic, we take the first descent, or rather the first three descents, of a plane upon ice far from shore in the polar sea. On 29 March 1927, Hubert Wilkins and Ben Eielson flew with skis northwest from Point Barrow, Alaska, with the thermometer at take-off around —40°. They planned to fly northwestward for about 6 hours, to the vicinity of latitude 80° N., longitude 180° W., where they would descend and take soundings. They would then fly south for 2 or 3 hours, and thence return to Barrow on a southeasterly course.

A hundred miles from shore the plane was already l the previously known region, for they had crossed th of the *Karluk,* a ship with which Wilkins had onc connected temporarily. They continued for 400 mi yond the *Karluk* exploration, when they had engine t which necessitated not only a forced descent but also t ski or wheel descent ever attempted on the pack fa shore.

Wilkins selected a landing spot he thought favorab pending, as he has said, on the experience he had gaine traveling over pack ice afoot during the years 1913–1 he was a member of the Canadian Arctic Expedit 1913–18. Eielson, schooled by North Dakotan and A winters, brought the plane down to a perfect landing. was in clear and nearly calm weather 500 miles from A sounding, which Wilkins took while Eielson was re the engine, gave more than 16,000 feet, so that the above the deepest place yet found in the polar sea. the repairs, the sky had clouded over, and snow was beg to fall.

After a take-off from pack that was made difficult softness and depth of new-fallen snow, they flew east little way, had engine trouble again, and made their descent in a snowstorm. They were still approximate miles from land.

We must pause here to remind those readers who a specialists in geography and climate that the frozen sea stormy in comparison with any ocean that is wholly This point was first emphasized by the American ex George W. DeLong (1879–81) and fully established (96) by Fridtjof Nansen, and by subsequent observe 40-mile-an-hour wind is as rare 50 miles from shore Arctic as a 60-mile wind is on the North Atlantic st lane between New York and Southampton. But 6 winds do blow on the North Atlantic, and a 40-mile

ɿg from the south before Eielson and Wilkins had repairs.

he second take-off the plane headed back toward ɟ fought this wind through the afternoon. Planes o fast in 1927 as they are now, and speed was cut ng like 50 or 60 miles. They continued through ht of the late afternoon. In this latitude at this ar, and with clouds in the sky, it is practically dark ck. At 9 o'clock, flying a mile high, the plane's pped for the third time, now for want of gas.

y thing to do was to keep straight against the wind ng the plane down as gradually as possible.

as a supreme test of a theory in practice. During expedition Wilkins had arrived at the belief that n have to go more than 5 miles on the northern sea before you find a patch of ice level enough and ıgh for an airplane descent and take-off. These ıen, are scattered; certainly 80 percent of the ice is ugh for a plane, perhaps 95 percent. Even in the ather there is open water here and there; for the tinually breaking under the stress of the currents. ces were then, at least 10 to 1, that in the darkness ing storm the plane would be injured; perhaps 1 20 that it would come down in open water. What , however, was that it descended on a fairly level here was not even a severe jolt. Only the fabric was slightly injured, torn by a snag of ice. This ever, was immaterial; for the plane, lacking gas, e to be abandoned. (There were not in 1927 such ıs now for rescue operations from the shores of the)

blizzard and darkness, Wilkins and Eielson, able ly a limited idea of where they were and how sit- nt to sleep in the cabin of the plane and had a od night. Morning found them drifting on a ize floe, surrounded by leads and patches of open he weather was still cloudy and there was not st, so that new ice did not form rapidly upon the r and the floes were comparatively free to move in hich appeared to be southeastward, parallel to the north coast of Alaska. An astronomical observation later showed that they were about 75 miles northwest of Point Barrow.

In 7 days the floe, with the camp on it, drifted about 200 miles in an easterly direction. Then the skies cleared and the weather became cold so that new ice formed, binding the floes together. Wilkins and Eielson now took their bedding, camp gear, rifles, and ammunition on their backs and started walking toward shore. They averaged 10 miles a day and made it in 10 days.[2]

The greatest concern, unquestionably, is about emergencies in the Arctic. The more one knows about the north country, the better prepared. In addition, full knowledge about the gear and equipment of standard arctic and Alaskan emergency kits is essential. But *know how* alone is not enough. It also is vital to check on the emergency kits to see that everything is present and in good condition. The combination of the right equipment and its proper use will almost invariably be the difference between being rescued in good shape—or even walking back to safety—and failure.

During World War II, the armed services have issued a number of excellent booklets on the Arctic. They include:

Arctic Manual: Viljhalmur Stefansson. Prepared under the direction of the Chief of the Air Corps, U. S. Army. 1944, N. Y. MacMillan, 556 pages.

Undoubtedly the finest single volume ever written on the Arctic. Makes fascinating reading.

Published War Department. 122 pages.

An excellent manual based on Stefansson's Arctic Manual, but of necessity, briefer.

[2] V. Stefansson, "Unsolved Mysteries of the Arctic," 1938.

Care of Personnel in the Arctic. Informational Bulletin No. 8. Arctic, Desert, Tropic Information Center, U. S. AAF. 1944. 12 pages.

A very brief pamphlet giving some practical information.

Emergency Living in the Arctic. Informational Bulletin No. 6. A. D. T. I. C. U. S. AAF. 1944 38 pages

A guide book of important facts.

Jungle, Desert, Arctic Emergencies AAF Flight Control Command, Safety Education Division, U. S. AAF. Pages 94 to 149.

Pocket size manual, with information similar to Informational Bulletin No. 6.

Survival on Land and Sea. Prepared for the U. S. Navy 1944. Pages 132 to 168 of a pocket manual devoted to Arctic Survival.

Aleutian Sense. Training Division, Bureau of Aeronautics, U. S. Navy.

An amusing pamphlet, chock full of advice to the tenderfoot.

In addition to the above items which are special manuals, the following more extensive books are of special interest.

V. Stefansson. The Friendly Arctic. MacMillan, N. Y. Second Edition, 1943.

R. E. Peary. Secrets of Polar Travel N. Y. Century Co., 1917.

V. Stefansson. The Arctic, In Fact and Fable Headline Series No. 51. Foreign Policy Assoc. N. Y. 1945.

H. Weigert and V. Stefansson. Compass of the World. MacMillan N. Y. 1945.

Arctic Pilot. Three volumes. Published by Hydrographic Department of the Admiralty. Reproduced by Hydrographic Office, U. S. Navy.

Crash fires

(Continued from page 17)

rescue operations which depend upon the use o curate sight. When heavy foam once covers openings it is very difficult to remove without the c application of pure water. Efforts by the wear remove foam from eyepieces with his glove may si streak the transparent surface, with only sligh provement in visibility.

A rescue man once wet should always be imr ately covered by a hand line and gun or applicat in emergency, a foam gun. This serves a tw purpose. It cools for protection against heat, insures direct contact with the asbestos-suit ma all times, so that he may be warned of backflash protected if he show signs of succumbing to Men should be kept under direct and close obs tion at all times both in training work and in a crashes.

It is imperative to not get gasoline on the clot The wearer may avoid pools and splashes, but h line and turret operators must avoid driving li gasoline onto rescue men by the gun blast.

In spite of the many limitations of protective c ing and the care with which they must be used, i hands of properly trained and experienced men permit early approaches to crash-airplane fires.

DURATION OF EXPOSURE

The degree of protection which may be exp from the use of protective clothing is occasic quoted as a specific time of safe exposure wi qualification as to the suit, underinsulation, or n of the fire. Caution is necessary in the use of figures as a basis of working endurance. The element is dependent upon the intensity of heat, w even away from the fire proper may be prohib With average asbestos suits and clothing worn t under an exposure of literally a few seconds to c flames and heat in the midst of a large gasoline may prove fatal. On the other hand, a crash c man may walk continuously with slight hazard thr spotty gasoline spill fires, which give the appea of continuous exposure to fire. No general, determined limitations have been authorita established.

Immediate physical reaction gaged by a prev carefully built up, working experience, is the sound basis to guide rescue men in their enduran protective clothing.

policy of the Bulletin to keep its readers informed lopment progress of important items of search and pment, regardless of whether or not the item has usly discussed in its pages. The Bulletin, in 1944, articles on signaling mirrors. However, believing would be interested in a complete, authoritative of this important piece of equipment, we are offer this timely article by Mr. Hunter of the ureau of Standards. Ed.

-size mirror will reflect flashes of sunlight readily n observer 10 or 20 miles away on a clear day. ch a small inexpensive device will produce signals onsiderable distances, all branches of the United ed services now equip their lifeboats, rafts and heliographic signaling mirrors. These are pocket-ion-resistant, reasonably flat mirrors of specially d glass or shiny metal which possess some means reflected sunlight. Three methods for aiming unlight have proved worthy of extensive use: earsight, and retroreflector. A foresight type of been widely used by the British in their survival The majority of mirrors produced for American have been of the rearsight type. Manufacture of the retroreflector type unfortunately did not start ldle of 1944, for this is without question the best e types. With a retroreflector-type mirror, a sig-ly has to look through a sighting window in the d a red spot which appears in space in front of , and then twist the mirror to put this red spot et.

ODUCTION

et-size mirror will reflect flashes of sunlight sible to an observer 10 or 20 miles away on ay. Because such a small inexpensive de-thus produce signals visible at considerable all branches of the United States armed ow equip their lifeboats, rafts and floats with hic signaling mirrors.

ors, mountain climbers, and explorers have r many years of the use of mirrors for signal-vever, mirrors were not included with Ameri-val equipment until the Rickenbacker search e early in the war focused attention on the a simple signaling device with which sur-a raft could attract the attention of passing number of reports were published, at about of the Rickenbacker search, of survivors from ings and downed aircraft who had success-rovised methods of reflecting flashes of sun-ard searchers from tin-can bottoms or other ects. One man, who is known to have urged opment of a signaling mirror, was a former rican Airways pilot who once located the of an airplane in the Gulf of Mexico only because survivors on the wreckage had been able to direct mirror flashes of sunlight at him.

To a passing observer several miles away, signals from a small mirror appear as bright, irregularly spaced flashes of light coming from a point in the distance which is usually near the horizon. The brightness which the flashes appear to have is determined by the size, flatness, and reflectance of the mirror, the distance between rescuer and survivor, and the clearness of the atmosphere. The frequency with which flashes reach the observer is determined by the skill of the survivor and the suitability of the mechanism for aiming mirror-reflected sunlight.

In September 1942 representatives of the United States Coast Guard, the Office of Strategic Services, and the National Inventors Council came to the National Bureau of Standards and asked for assistance in

heliographic signal

By Richard S. Hunter, National Bureau of Standards

Rear side of aluminized, tempered-glass signaling mirror manufactured by the General Electric Co. and intended for rearsight aiming (Courtesy of General Electric Co.).

ing mirrors

Four methods of aiming mirror flashes of sunlight: (1) improvised foresight, (2) foresight (British mirror), (3) rearsight (General Electric mirror) and (4) retroreflector.

designing a practical signaling mirror which could be packed with life rafts, lifeboats, and other survival equipment. Three questions were raised: (1) What are the best mirror materials from the standpoint of shininess, ability to resist corrosion, and resistance to breakage? (2) What size and flatness must a mirror possess to produce flashes of sunlight bright enough to attract the attention of an observer in any passing aircraft or boat likely to be seen by a survivor? (3) What simple and effective means can survivors employ to aim mirror flashes of sunlight toward a passing craft?

The first two questions were readily answered by information already available plus the results of a few trials and experiments. To the last question, however, there was no ready answer. A few trials soon showed that mere guesswork in handling a mirror without some accurate scheme for aiming flashes would not work. If one fails by only half a degree to face a mirror half way between the sun and the target, the mirror signals will not reach the target. Within a few days of the receipt of the request for assistance, however, L. L. Young, then of the Bureau staff, had devised the rearsight method for aiming mirror flashes and had shown that it was accurate

and could be readily provided for in the man ture of small mirrors.

Suggestions for other methods of aiming mirrc nals came from other sources. Unquestionabl best of these is the retroreflector method whicl submitted by its inventor, C. H. Learned, of Califc to the National Inventors Council, several months Young had suggested the rearsight method.

II. MIRROR MATERIALS

The materials from which good, shiny mirror be made are all familiar, excepting perhaps for rorized transparent plastic sheet which has app only recently. Signaling mirrors of evaporated a num on glass and of precipitated silver on glass been widely manufactured in spite of the objectio brittleness of glass. With some mirrors, this objec able feature has been partially overcome by prior treatment of the glass to increase resistance to b age. With others, the glass has been mounted cushioning metal and rubber frame. Coatings o quer or paint are, of course, applied to the metal on these mirrors to prevent corrosion.

Signaling mirrors have also been made of chron plated brass and steel. To obtain satisfactory ı ance to corrosion from mirrors of this type, the pl must be well applied, or it will not prevent corrc One survival account brought to the writer's atte demonstrates the importance of corrosion resist A flyer forced down in the South Pacific had adrift 2 weeks when he sighted a patrol plane. though the sun was shining at this time and the knew how to operate his chromium-plated sigr mirror, he was unable to signal because of the c sion of the mirror. Only the sharp eyes of the of the patrol plane brought about his rescue.

Stainless steel has good resistance to salt-spray rosion. Although the British made a good sign mirror of polished stainless steel, it is believed th American agency tried using this material, in because it was in short supply during the war, aı because it did not readily lend itself to the types of struction being tried. Recently, the developme a stainless steel Scotchlite type signaling mirroı been undertaken. Having both resistance to brea and resistance to corrosion, stainless steel would to be an ideal material for signaling mirrors.

The possibilities of mirrorized transparent p are not known. Good plastice mirrors can aı ently now be made by both evaporation and cheı precipitation of metal films on transparent sheet otherwise practical, plastic signaling mirrors w

the advantages of light weight with freedom ttleness. The plastic mirrors examined to vever, have all tended to warp in warm humid ›res till they failed to comply with the ex- ally established requirements for mirror flat- ch are described below. Until this tendency can be overcome, as it may be in some of the developed plastic materials, signaling mirrors : will continue to prove unacceptable.

r reflectance, which might at first seem an ıt consideration in the choice of a mirror is actually of secondary importance. Of erials mentioned above, a clean mirror of glass will reflect more than 90 percent of which strikes it at 45°, a mirror of aluminum will reflect about 85 percent, chromium- rass or steel 60 to 65 percent, and polished steel, 50 to 65 percent. Although the differ- brightness between flashes from like-sized of the best and the poorest of these materials : perceived if the flashes were viewed simul- y and side by side, the flashes would be of so ıe same brightness that there would be little :e in their power to attract the attention of ver. Slight bending or warping of a mirror much more serious loss of signal brightness.

IRROR DIMENSIONS AND FLATNESS

nmended sizes and flatnesses for signaling were obtained from the results of experiments ›d over an 8-mile range across the city of ;ton. Because it is unlikely that a survivor any rescue craft more than 8 miles away, it that mirrors giving effective signals over this ould be suitable as items of survival equipment. ›s of sunlight from a nonflat, 2-inch square, -steel signaling mirror were seen across this ange. The flashes were not bright, however. other hand, flashes of sunlight from every vhich was 3 by 4 inches in size or larger, and flat, were quite bright.

.y thus be said that a mirror which readily one's pocket is large enough to be an effective ; mirror. In American survival equipment, about 3 by 4 inches in size are usually found sts and small packs where space and weight premium. Mirrors 4 by 5 inches or 5 by 7 re found in lifeboats, in large packs, and where ıd weight are not so vital.

›rs of these sizes must be nearly flat to be A perfectly flat signaling mirror will reflect of sunlight into space which has the form of a cone 0.5° in diameter measured from the mirror. This is because the sun is 0.5° in diameter when observed from the earth. If a mirror is not flat, the spread of the beam of reflected sunlight will be greater and the flashes of reflected sunlight will be correspondingly dimmer. In the experiments over the 8-mile range it was found that slight warpage improved a signaling mirror because the additional spread of the reflected beam caused suitably bright flashes of sunlight to reach the observer with greater frequency than from a perfectly flat mirror. A limit was found to the amount of warpage which could occur before the loss of brightness of the reflected flashes became serious.

The amount of warpage was measured on a mirror-planarity meter designed by M. K. Laufer of the National Bureau of Standards. With this instrument the beams of light reflected from different parts of a mirror under test were measured for their angular deviations from the direction of reflection by a flat mirror. The signals from a 4- by 5-inch mirror began to show serious loss of brightness when the average deviation of the beams from the direction of reflection by a flat mirror was about 1°. With a 3- by 4-inch mirror this figure was about 0.6°.

The sagittal distance of a 4- by 5-inch concave or convex mirror with maximum permissible curvature is about 0.020 inch, that of a 3- by 4-inch mirror with maximum permissible curvature is about 0.010 inch. Although care is necessary to avoid warping the strengthened-glass mirrors during heat treatment and the metal mirrors during mechanical finishing, the required planarity is not difficult to obtain.

IV. FORESIGHT TYPE MIRRORS

Four different methods for aiming mirror-reflected beams of sunlight are illustrated in figure 1 in the order of their effectiveness. The methods shown in squares 1 and 2 should both be called foresight methods of aiming a mirror because in each sunlight is reflected from the mirror onto a nearby object in the signaler's line of sight. Square 1 illustrates an improvised method of foresight aiming and square 2 shows the operation of a foresight signaling mirror built for the purpose.

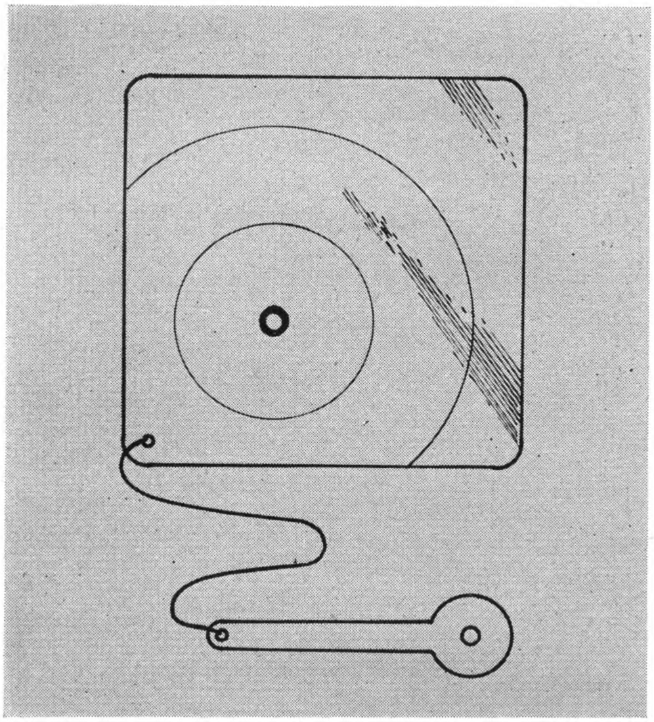
From the accounts of survivors who have successfully improvised mirror methods of signaling, it appears that when prepared signaling mirrors are lacking, an improvised method of operation similar to that shown in square 1 is most likely to be successful. There is a question whether the particular two-man method of operation shown should be used in a boat craft on rough water. The motion of the men

makes it difficult to keep the foresight near the signaler's line of sight to the target. The signaler may be more successful if he uses his own hand as a foresight.

On land, where the signaler is not in continuous motion with respect to his surroundings, it is easier to keep a foresight in line with a target. Sometimes it is convenient to use a part of a bush or tree as a foresight. Flashes of sunlight from a toilet mirror, a tin-can bottom, or a plain piece of glass can be aimed quite easily and accurately by one on firm ground. For successs, the alinement of the signaler's eye, the mirror, the foresight, and the target must be made carefully.

It is quite usual to find an individual practicing the

British 4 by 4 inch stainless-steel signaling mirror with white-painted metal key.



foresight method of signaling who thinks he is directing flashes to a distant target and yet does not hold his mirror close to his eyes. Although one sees reflected light striking the foresight, and the foresight is properly in line with the target, signals will not be directed toward the target unless the mirror-reflected beam of sunlight and one's line of vision start from essentially the same location. Failure of the signaler to hold his mirror close to his eyes is a very common error of the improvised foresight method.

With mirrors manufactured for foresight aiming, correct alinement is assured by sighting through holes. Foresight-type pocket signaling mirrors of practically the same design have been proposed by C. H. W of California and T. D. Robertson of Australia they have been procured and issued as survival e ment by the British armed services.

The British stainless-steel signaling mirror s in figure 2 is 4 by 4 inches in size and 1/16-inch t The key, attached by string to the mirror, is pa white. Rings concentric about the sighting hole been scratched on the shiny face of the mirror. T enable the signaler to tell from the shadows of rings on the white key which way he must tur mirror to bring the shadow of the dark spot and ing hole onto the center of the key. The pro confronting a signaler such as is shown in square figure 1 is to keep his line of sight through the m and keyhole aimed toward the target, and at the time keep the shadow of the sighting hole cen on the keyhole.

V. REARSIGHT TYPE MIRRORS

The rearsight method of aiming a mirror-refl beam of sunlight makes use of the small pen sunlight which comes through the sighting There must be a rearward mirror surface surrou the sighting hole in addition to the mirror su facing forward. The pencil of sunlight which c through the sighting hole is intercepted by som ject behind the mirror, such as the signaler's fa hand, and is then observed by reflection in the ward mirror surface. (See fig. 3 or square 3 of fi It is the task of the signaler to turn the mirror so the reflected image of the intercepted spot of disappears from the rearward mirror surface int sighting hole at the same time the line of sight th the hole is directed to the target. Aiming a mirr the rearsight method is not a simple task.

The rearsight scheme for emergency signaling rors appears to have been first suggested by T Robertson[3] in Australia. Robertson's sugges were slow in reaching the United States, and L. L. Young, formerly of the National Burea Standards, and W. M. Potter, of the General El Co., conceived the rearsight scheme independ while working on signaling-mirror possibilities in 1942.

[3] *See Australian patent 117,760 issued November 25, to Thomas Dunn Robertson for an improved mirror sig device. According to this patent, Robertson's initial cation was accepted January 12, 1940, but since the covers both the foresight and rearsight types of sig mirror, it is not possible to say with certainty that the sight scheme for aiming signaling mirrors was sugges 1940.*

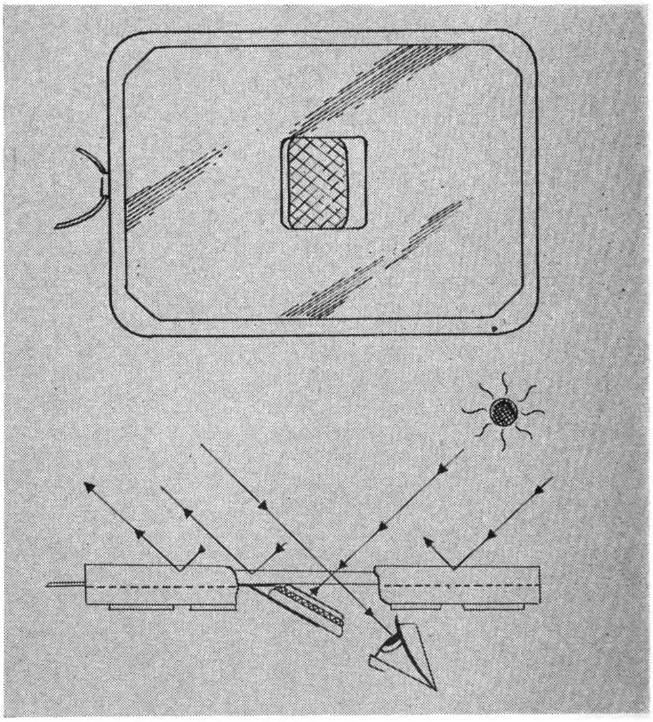
xcellent rearsight mirror of Potter's design, g his original specification of tempered glass, ed in production by C. F. Perkins of the Gentric Co. and widely distributed with American equipment. One type is shown in a rear-view aph (Fig. 3).[4] The mirror is of evaporated m on tempered glass which will not break opped from a height of 5 feet onto a hardwood The sighting hole is in the shape of a cross so signaler has a somewhat wider field of view ound hole would give. For a rearward mirror surrounding the sighting hole, the evaporated m film of the mirror was coated with only a ugh lacquer. The rear of the mirror with its ons and the circular reflecting area are shown 3.

ight signaling mirrors of sheet steel chromium-n both sides have been made. Although these do not possess the susceptibility to fracture of rrors, the resistance of many of them to salt-rrosion is poor. In addition, many of them en found to be seriously warped, either due to ness in manufacture or to the use of sheet metal to resist bending in handling and shipping.

TROREFLECTOR-TYPE MIRRORS

idea for the retroreflector type of signaling vas submitted to the National Inventors Counuse in the war effort by a Californian named earned. He proposed that an aiming meche made by fastening a retroreflector of one of es widely used in night-visible traffic signs a glass of plastic window in a mirror. Whenlight strikes the front of this mirror, that part asses through the window strikes the retroreand starts to return toward the sun. Some of m of reversed sunlight is reflected to the rear two surfaces of the glass or plastic window. two surfaces are parallel to the surface of the it is easy to see that the direction taken by this ected beam (usually colored red by the retro-) will be exactly opposite to that taken by the irror-reflected forward beam. This is shown wer part of the drawing, figure 4, of the Signal Corp.'s model of emergency signaling mirror. rearward beam is seen as a red spot by the who places his eye beside the retroreflector osition shown. This red spot is actually an imy formed image of the sun appearing in space direction in which the mirror is reflecting sunlight. In comparison with the foresight and rearsight types of signaling mirror, the retroreflector type of signaling mirror has three important advantages: (1) The method of aiming is not complex; the survivor merely holds his eye behind the mirror, observes the red spot appearing in space, and turns the mirror until this red spot appears to coincide with the target. (2) There is no difficult problem of focussing the eye because the red spot appears at a great distance in front of the mirror. With the other methods of aiming, it is necessary for the survivor to look repeatedly from nearby to a target in the distance and back again. (3) The survivor has a large field of view because the mirror window is fairly large and he can hold his eye immediately behind it.

Retroreflector-type mirror manufactured by the Signal Service Corp. Part of case is cut away to show directions of rays involved in signaling.



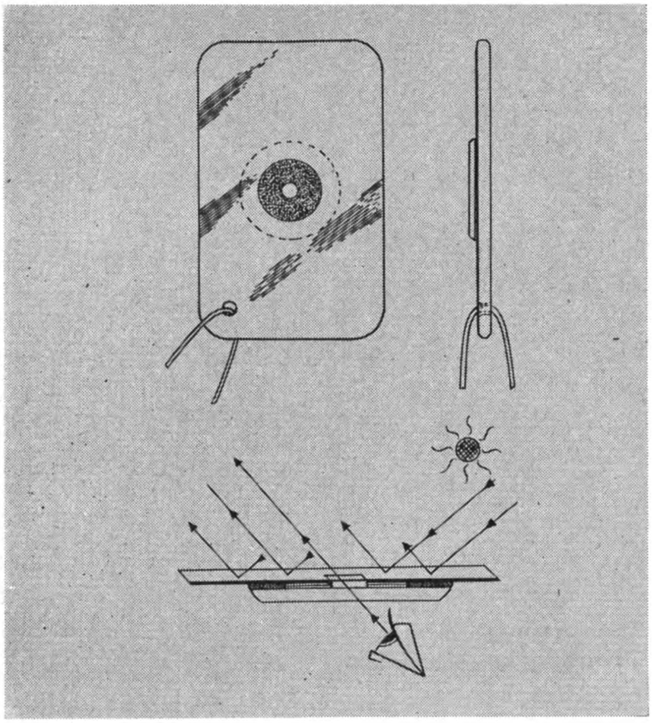
The Signal Service retroreflector-type signaling mirror shown in figure 4 uses an ordinary silver-backed glass mirror built into a cushioning frame and has, as an additional feature, retroreflectors which face rearward for possible use by a survivor in a night rescue. However, the signaling mirror has one disadvantage which it has been possible to eliminate in a recently designed retroreflector-type signaling mirror. The mirror shown in figure 4 must be rotated in its own plane till the retroreflector faces roughly toward the

[4] rticle entitled "Solar Searchlight," by W. M. Potter, Electric Review 47, p. 7 in May 1944 issue.

sun before the red spot can be seen by looking through the viewing window. The proper positions of reflector, sun and signaler's eye are indicated in figure 4 and in square 4 of figure 1.

A retroreflective material manufactured by the Minnesota Mining & Manufacturing Co. comes in the form of sheets to which small spherical glass beads have been affixed. Its brand name is Scotchlite. One form of this material is well suited for making retroreflector-type signaling mirrors. It can be cut into washers with sighting holes in the center and each

Retroreflector-type mirror made with Scotchlite washer behind round window in tempered-glass mirror by the General Electric Co. Cross-section of aiming mechanism below shows directions of rays involved in signaling.



washer can then be mounted behind a round window of glass or plastic in a mirror. When the retroreflector has this washer shape, it makes no difference how the mirror is turned in its own plane; the necessary rearward beam to form the red spot will always come back through the sighting hole. The Scotchlite-type of signaling mirror which the General Electric Co. has made with an aluminum-coated, tempered-glass mirror and disk-shaped protecting cover glass is shown in figure 5. This improved signaling mirror had not reached quantity production at the time the war ended.

VII. COMPARATIVE TEST OF SIGNALI MIRRORS

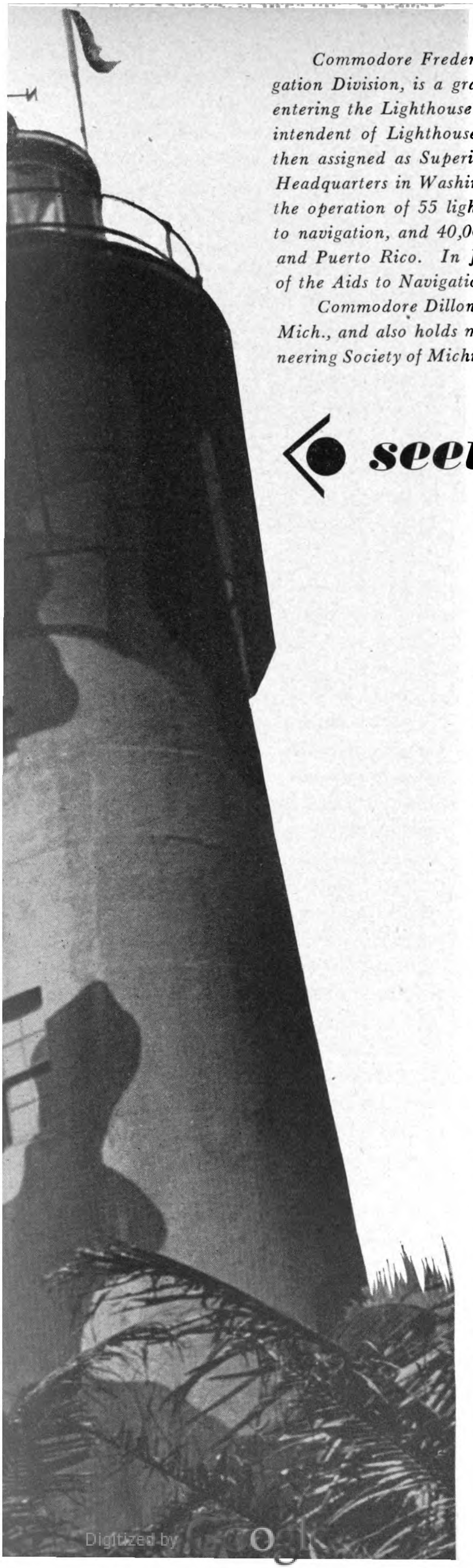
To compare some of the above types of m for effectiveness under simulated survival c tions, a series of tests was conducted in May at the United States Coast Guard Air Station, I beth City, N. C. The mirrors compared wer erated by the four methods illustrated in figu Unfortunately the Scotchlite type of retroreflector ror shown in figure 5 had not been developed a time.

To operate the signaling mirrors, six subjects no previous knowledge of these devices were ch from among the machinists at the station and divided into three two-man teams. The first were used to find how rapidly the proper method aiming mirror-reflected flashes of sunlight coul learned from the instructions and diagrams supp Between 2 and 3 minutes was the average peric time required by the teams to learn each of the methods of aiming. There were thus no signifi differences in the ease with which the various ai techniques were learned.

On the following day, the subjects were taken radio-equipped cabin cruiser to an area in Alben Sound where the water was somewhat choppy there a four-man rubber raft was tied to the ster the anchored boat. Between 10:30 and noon a sc ing plane repeatedly passed around the boat and at an elevation of about 500 feet. It always proached from the up-sun direction, circled 2 r from the raft, and then left to go 6 miles up-sun be turning for the next run. The small scouting p could be seen only when it was within about 4 r of the boat. During each circuit, one team of in the raft tried to signal with two of the four mir One man signaled for 30 seconds with one mirror then for 30 seconds with the other before relinq ing both to the other man in his team.

An observer in the scouting plane reported by r the number of distinct flashes of sunlight whicl saw during each 30-second period. A comparisc two mirrors was made during each run so that v comparisons would be obtained even though cha in the subject's ability or the weather might ch the rating scale during the course of observat Fortunately the average rate at which flashes received from any one mirror did not change m edly, either with changes of subjects, or with cour the experiment. Thus the results can be summa

(*Continued on page 48*)



Commodore Frederick Paul Dillon, USCG, present Chief of the Aids to Navigation Division, is a graduate civil engineer from the University of Illinois. Upon entering the Lighthouse Service in 1911, he was appointed a district assistant Superintendent of Lighthouses and served in this capacity until January 1927. He was then assigned as Superintendent of Lighthouses on general duty with Coast Guard Headquarters in Washington, D. C. In connection with this position he checked on the operation of 55 lightships, 50 lighthouse tenders, 600 light stations, 23,000 aids to navigation, and 40,000 miles of waterways of the United States, Hawaii, Alaska, and Puerto Rico. In July 1942, he was appointed to his present position as Chief of the Aids to Navigation Division.

Commodore Dillon is a charter member of the Engineering Foundation, Detroit, Mich., and also holds membership in the American Society of Civil Engineers, Engineering Society of Michigan, and the Washington Society of Engineers.

seeing eyes for mariners

By Commodore F. P. Dillon, USCG

An aid to navigation is a device, external to a vessel or aircraft designed to assist the navigator thereof in determining his position or safe course and in warning him of dangers or obstructions to be avoided which constitute hazards to safe navigation. Such a device may reveal itself to the navigator through the medium of light waves, sound waves, or electronic impulses. In more simple terms, it is a mark or guide for the mariner or navigator.

A navigational device on a vessel, for example a compass, a radio direction finder, or a sounding machine or instrument is not an aid to navigation.

It is of interest to note briefly the development of aids to navigation systems and their characteristics from colonial days to the present time. Lighthouses with their lights may be classed as primary or landfall, coastal, sound, bay, and harbor lights. There were 12 colonial lighthouses and some buoys and other aids turned over to the Federal Government (act of 1789) "to make navigation easy and safe."

Legislation required that "the light in the * * * lighthouse shall be such as * * * to distinguish it from others and * * * prevent mistakes" (act of 1792).

Judging by present-day concepts the lighting system of our waters was inefficient until after the introduction of the Fresnel lighting apparatus by the Lighthouse Board of the Treasury Department after 1850. The following is an estimate of the efficiency of the system taken from Government records in 1842:

(*a*) The lighthouses, while listed by latitude and longitude, were not accurately located on charts available to the navigator.

(*b*) They were not readily identified as daymarks by the navigator unfamiliar with the region.

(*c*) There was often no way of distinguishing the lights one from another on dark nights.

(*d*) The distance the lights could be seen on clear nights was often erroneously listed.

(*e*) There was no accurate method of comparing the intensity of one light with another, such as listing the candlepower.

The Light List of 1842 listed no sound signals, and the mariner had to have plenty of native ability to pilot his ship safely along our coasts and in and out of port in the sailing days. No systematic charting of the coasts was scientifically developed until after 1850.

Crew of a Coast Guard Buoy Tender repair a light buoy in the channel of an eastern American port.

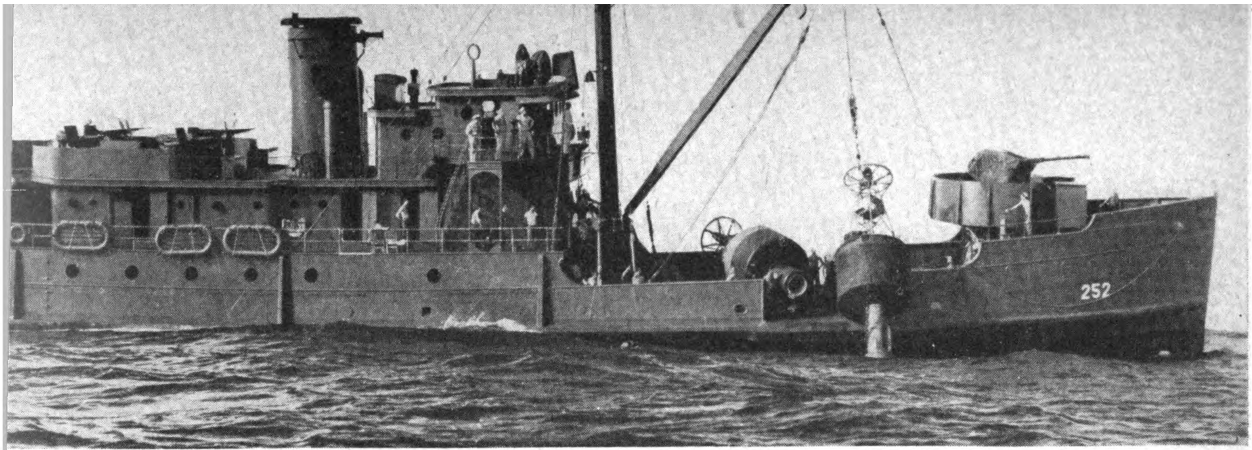
I. W. P. Lewis, a civil engineer, commissioned by the Treasury Department in 1842 to inspect and report upon the condition of the lights and lighthouses of our coasts, reported among other things more than 50 wrecks on Cohasset Reef and its immediate neighborhood, in chronological order from 1833–1841, by name of vessel and date of casualty. After congressional investigation the Lighthouse Board in the Treasury Department introduced the Fresnel optical system of lighting apparatus from France. This system is capable of producing any desired characteristic, color of light, and candlepower dependent only on the variations of the arrangement and design of the optic, the color screens employed and the illuminant used. problem of the lighting system in this countr solved progressively from that day to this. Difi concepts of the Fresnel principles are employe major lights, minor lights, and range lights.

The navigator's experience has shown that the period for best identification should not be of less t second duration and the characteristic in its en should recur in not over 10 seconds in order th ship shall not travel too far between the times c servation and identification of the characte The colors white, red, and green may be used for l lights and the candlepower of each should not b than 50,000. If we were starting all over aga develop a standard piece of lighting equipmer the larger lights for a whole new system of su vessels and aircraft, we would design the appa with 2-second flash, 8 seconds eclipse, and coun identification flashes of ½ second length of the ber 0 to 4 or 5, combinations possible in any one of apparatus. Stations 0, 1, 2, 3, 4, and 5 v recur down the coast and further recurrence of tical characteristics could be extended by using v green, or red lights and their combinations as req for positive identification.

The United States uses the lateral systems of l and channel markers. Buoys and channel ma are given shape, color, numbers, and other di tions as a means of indicating which side of a ch they mark, and for other purposes. Further ra cations of the system are the assignment of colo lights and the providing of these lights with de characteristics, or light rhythms, as lateral ma and for special auxiliary purposes.

In addition to the lateral markers there are aids auxiliary to the system for special purposes as solid white color buoys for anchorage grounds, yellow color for quarantine anchorages, black white horizontally banded buoys to mark the lin areas for fishing reserves, and white buoys with tops to mark dredging and dumping ground are

Crude buoys were mentioned in the Delaware l as early as 1767, made of staves and spars, wi color or shape significance. In 1838 Governme ports stated some systematic mode of designatin positions of buoys would be of great utility to even those who may be familiar with navigation, ticularly in narrow and tortuous channels. To duce the best results simplicity must be preservec at the same time a sufficient number of distinc introduced; the colors red and black have been



Guard Tender hoists a buoy aboard somewhere in the Atlantic. The crew will paint it, fuel it, and check it for adjustment or repair.

n account of showing best upon the water, and ıoys are painted, there can be no objection on e of economy. This suggestion came from a ficer in 1838 when artificially dredged channels known in this country and only natural chan- re being marked. Now we have more than tatute miles of waterways in the United States nd thousands of miles of dredged channels.

present system of colors and numbers used in ral system in the United States (but without ation of shape characteristic such as rectangu- and triangular nun shapes) was prescribed by s in the act of September 28, 1850. Shape on of lateral markers (rectangular can shape ıngular nun shape) was based on the Inter- Conference of 1889 at Washington, D. C.

hted buoys had not come into general use in ght color and characteristics or rhythm, for or other significance were at that time not ly made or standardized.

ighthouse Service of the Department of Com- shortly after 1931, adopted a simple plan of lors with distinctive fixed and flashing lights ys and lateral markers at night according to ırpose and consistent with its previous Inter- proposals.

lateral system, where the usual rules obviously apply, arbitrary coloring and numbering are d according to law and to suit conditions. ring and numbering of buoys along the coast ng traffic routes not leading from seaward, or headwaters, the principal assumptions are as

eding in a southerly direction along the At- ɔast and in a northerly and westerly direction along the Gulf coast will be considered as proceeding from seaward and accordingly coastal buoys on the starboard hand are red in color. Proceeding northerly along the Pacific coast is similarly considered. Proceeding northerly and westerly on the Great Lakes is considered as proceeding from seaward. Proceeding along the intracoastal waterway in a general southerly direction along the Atlantic coast and in a general westerly direction along the Gulf coast is considered as proceeding from seaward.

A quick idea of the lateral system of minor aids may be obtained by study of the colored illustrations in the Light List of the Intracoastal Waterway. The triangular nun and the rectangular can shape apply as to lateral significance both for fixed and floating aids. The color *yellow* indicates the aid is part of the intracoastal waterway system. The color and rhythm or characteristics of the lights are standard throughout our lateral system and are reduced to the minimum required to explain every situation to the mariner or navigator.

The colors red, white, and green are standard. No flash is of less than 2 seconds duration. Shorter flashes make a poor impression on the eye; i. e., a pointer bearing is difficult if not impossible to obtain. The light seems to skip about between flashes. Some of the standards adopted for quick recurrence of lateral marks are a 0.4-second light and a 3.6-second eclipse; white, red, or green according to lateral significance. The saving in illuminent depends on the reaction of light period to dark period. For an approach light where time is not a particular factor to the navigator, one standard characteristic is 1.0-second light 9.0-second eclipe of 1/10 period, which is a good light period on which to take a pointer bearing; i. e., the light does

not appear to jump around badly between observations.

Several thousand lights on buoys and fixed structures have a standard characteristic of 0.4-second light 3.6 second eclipse of 1/10 period. It is obvious that this standardization of characteristic increases efficiency of maintenance.

In regard to the light characteristic for ranges, the colors red, white, and green are standard. In the interest of economy all ranges would be fixed white lights except as seen against a background of city white lights. To meet this objection they are often paired as green or red lights and may be given certain standard characteristics such as:

Front flashing or occulting, rear fixed or occulting, depending on economical considerations. For example:

(*a*) Front synchronized with rear on a commercial circuit.

(*b*) Front 0.3- or 0.4-second light rear 3.0-second light by 3.0 eclipse.

Hundreds of ranges are standardized with this latter characteristic. The colors may be white, red, or green paired.

The lightship serves as a floating lighthouse. With all the signals of the light stations, the powerful light, the sound signal, and the radiobeacon, it is placed at the most strategic locations to serve the most important traffic. It is probably the most important aid to navigation we have and the most expensive to maintain. One of its advantages is that it may be moved to a new position at no additional expense. Lightships were first established in 1820, their numbers have increased rapidly until there were more than 40 stations in 1850 and more than 50 stations in 1915.

In certain periods lightships in shallow, protected waters were replaced by lighthouses on marine sites. The development of electronic aids since the radiobeacon has tended to convert manned lightships to unmanned automatic lightships. There are now, or soon will be 28 lightships on various stations.

After more than 100 years we still make good use of the warning of the fog signal and actually measure distance and direction from the station where radio and sound signals are synchronized. A compilation of characteristics of sound signals indicate that certain characteristics should be standardized. The length of the blast as determined from many hundreds of observations should not be less than 1½ seconds duration to give a good pointer bearing on its source. The silent period is determined by economical considerations, power consumption, size of air st tanks, and other factors. A continuous sound is but that would be intolerable. However, the s should recur frequently and be readily distinguis from boats' whistles and similar sounds in the d area. Two seconds' blast and thirteen silent excellent signal; 2 by 18 is all right, 3 by 27 w very well. The engineer aims at 1/10 perio economy. Double blasts on 1/10 period mak distinction.

Among other systems of aids to navigation, the r beacon system was most recently developed, h come into being since 1921. Radiobeacons are transmitting stations installed at points shown o charts for the purpose of sending out radio sign all directions for the guidance of marine navig in clear and thick weather. The mariner rega of fog or thick weather, if provided with a dire finder, can take bearings on radiobeacon station manner similar to the use of his gyro or mar compass. The use of radiobeacons reduces the d of collisions as well as strandings, and enables the gator to follow desired or prescribed courses or congested routes. By means of the direction fin vessel in distress giving out radio calls can be tr down by the direction finder ordinarily used for r beacon signals and rescued, even in thick wea Navigating time in the operation of a vessel c reduced by the use of radiobeacon signals an over-all efficiency of navigation increased, resu in economy of vessel operation.

The Coast Guard system of radiobeacons o coasts, in important bays, sounds and waterways on the Great Lakes is complete except for reac ments in the system, for marker radiobeacons an introduction of radiobeacon buoys. As of Nove 6, 1945, there were over 185 radiobeacons in th tem, graded as to power or range into classes A, B C, and class D for marker radiobeacons. Cla marker radiobeacons are generally for close navig on entering ports and are not usually attended, t fore not synchronized in the system. Class A wi approximate 200-mile range, class B 100 miles, class C 50 miles, are trained to operate 1 minut of 3 in thick weather (radiobeacon weather) to w 5 seconds of absolutely correct time. The signal a specially redesigned Morse-type letter repeate 1 minute, easily recognized by any mariner wit

ning. The silent period is 2 minutes. The
: sees that this signal continues in this sequence
ıg or thick weather. Each station is on an
:requency. Operating 1 minute out of 3 you
ily see how 3 radiobeacon stations can be
on the same frequency in a group conveni-
ıted and on which the navigator may get a
ıy cases. In clear weather, for general navi-
rposes, the stations generally operate for two
e periods out of each hour. This operation
omatic.

tendant checks the timing of the signals and
hem to Arlington or other reference time
astronomically checked. These radiobea-
on lightships or at light stations with a per-
omplement, although the transmitters are
cally operated from commercial current or
l current power sources.

ederal Government encourages private par-
ndustry, municipal, State, and other govern-
gencies to establish and maintain aids to
n in Federal waters at the expense of the
r when these aids are used exclusively by
oner and not for general navigation and es-
with characteristics by the Coast Guard so
conflict with its system. The enforcement of
and regulations governing private aids to
n is the responsibility of the Coast Guard
legated to its Aids to Navigation Operating
These private aids, intermingled with Coast
ds, shall be maintained as authorized with
characteristics and must be inspected pe-
to see that they are properly maintained.
re isolated and not confusing in relation to
t Guard system, authority for their establish-
l maintenance may be given informally and
t Guard does not record or assume responsi-
their maintenance. The responsibility for
due to misinformation of such marks, or
ons caused by them when not registered or
by the Coast Guard, is not that of the Coast

oast Guard has the responsibility of enforc-
ral laws regarding the lighting of bridges,
oms, piers, dams, and similar obstructions to
n.

ıdard lay-out of lights for every type of
ıs been prepared and owners of bridges are
to light their bridges in accordance with these
lighting schemes. They submit lay-outs for
and, after these are approved, must maintain the lights in efficient operating condition. The Coast Guard aids to navigation operating officer of each district arranges for inspection of the lighting of bridges.

Aids to navigation and charts go hand in hand. A complete knowledge of the subject involves a complete understanding of that branch of navigation known as piloting. For offshore aids, celestial navigation is involved, such as the location of buoys and lightships out of sight of land. An aid to navigation improperly located, even though properly charted, is a menace to navigation.

Light lists are catalogs of aids to navigation, published annually, for which the aids to navigation operating officers of the Coast Guard are responsible. These lists, among other things, accurately describe aids, give their assigned characteristics and include a correct list of all aids briefly described for the mariner, giving location, appearance from seaward, and much other essential information compactly arranged in columnar form for ready reference. The statistical and compilation work on the lists is considerable and it is obvious that accuracy is of the essence.

Dissemination of timely and accurate information to mariners and shipping interests, in regard to establishment, changes, improvements, and discontinuance of aids to navigation for the vast system of more than 30,000 aids to navigation subject to collision and casualties of the sea is a direct obligation of the aids to navigation operating officers of the Coast Guard. An aid to navigation which gives out false or erroneous information as to location, characteristics, or is irregular, is a menace to the mariner, not an aid. Dissemination of information may be in the form of weekly Notice to Mariners, local notice to mariners, radio broadcasts, or even circular letters. Communications in all forms enter the picture.

The aids to navigation operations officer spends approximately 20 percent of his time inspecting lightships, light stations, important buoys, depots, and aids to navigation systems in the field, delegating operational inspection to others capable of inspection in certain areas to see that the operation of aids conforms to the requirements of the light lists and the aids to navigation operation bill which shows at each station the systems operational requirements. Only a trained expert in aids to navigation operation is capable of making this inspection and submitting a report from which the system's operation may be kept efficient.

The following article has been prepared from material contained in a speech delive Commodore Webster in New York in October 1945, before the Propeller Club of the States on the American Merchant Marine Conference. Commodore Webster is a reco authority on all phases of radio communications, having attained national prominence work in coordinating the Government's communication activities. Graduating from the Guard Academy in 1912, he served on various ships and stations and for several years Coast Guard's chief communications officer. He retired in 1934 to become assistan engineer for the Federal Communications Commission. Recalled to active duty with the Guard in 1942, he was reassigned to his former duty as chief communications officer, a recently appointed to the rank of commodore. He has represented the United States at international communications conferences—Washington, Madrid, Cairo, Rio—and in attended the Safety of Life at Sea Conference in London. In recognition of his leader promoting measures for enhancing the safety of life at sea, and for his contribution to the d ment of the maritime radio services, Commodore Webster was recently made a Fellow Institute of Radio Engineers.

radio for rescue

WHAT WE HAVE LEARNED FROM THE WAR

By Commodore E. M. Webster, USCG, Chief Communications Officer

WE are now on the threshold of putting into actual use for our peacetime pu those devices which were developed or improved during the war period. for us to choose those things which have promise of being valuable to the ma

, no new device or system will be actually e or useful to ships until it has passed through s of the mariners and navigators under prac- rating conditions. These are the real users : are the people who should play a large part ›pment.

you would consider the word "rescue" as -embracing because it is difficult, in fact im- to point to any portion of the subject of radio "This application of radio is strictly for res- wish to consider radio in relation to the entire f safety and distress on and over the water. ot treat the use of radio in the marine field from, and without relation to, its contribution fety of aircraft flying over the oceans.

received its greatest impetus initially in its on to marine uses. Through all of these .rs, all users of radio have recognized the num- priority of ship radio communication in con- the needs for radio frequencies and facilities. ips and aircraft have been saved and many and rescues have been made successful this medium. But the progress of radio in ie field has been along conservative lines. No r revolutionary changes have occurred.

: we should be perfectly fair with ourselves— iterests have in recent years contributed little new in the application of radio to safety and The tools for navigating and communicat- dio have remained the same throughout the hey were before. Improvements have been course—the range of communications in- and more and better equipment installed.

n the aviation field that we find the most ar development in the use of radio for naviga- ty, and rescue. We must appreciate that it his wartime development that the merchant vill receive its greatest contribution in the use I believe the merchant marine could be sed to join hands with the aviation industry ping the art of radio for the benefit of both

ft, in particular, when flying over the water e operated safely or efficiently and cannot ir travel which will be acceptable to the pub- out the direct and intimate use of radio. of paramount importance. Constant and contact with the ground must be maintained ies while the aircraft is in flight; it must be uide itself over the designated route, it must distance from the earth's surface—modern- lards necessitate the positive, safe and efficient landing and taking off. Radio has revolutionized the methods employed in doing all of these things. You will find the aviation industry devoting much time and money to the planning and development of new uses for radio. It is a major project in that industry. Consequently, in the consideration of radio problems, aviation has moved in with the maritime for the number one priority position.

In August of this year, I had the opportunity to attend, as an observer, the Third British Commonwealth and Empire Conference on Radio for Civil Aviation held in London. I saw some of the many developments in radio, as applied to the aviation problems which were brought to light by war experience. I heard the many plans of the British Empire, discussed by high officials, for the use of radio by British civil aviation. To them it is a live and a very real problem. The importance of the subject was attested to by the presence of leading representatives from the dominions and colonies of that Empire.

During the month of September, I was in attendance at the Third Inter-American Radio Conference held in Rio de Janeiro. While this was a Western Hemisphere conference for the purpose of discussing many phases of radio as applied to the Americas, I found upon arrival that one of the foremost topics for consideration was that of the application of radio to aviation. The countries to the south of us were eager to learn of the new developments in the field. Security requirements had kept much from them, even as it had from you. However, marine radio problems were conspicuous by their absence.

I am aware of other conferences, both regional and international, which are in the making in which the subject of radio and its possible uses in aviation as well as in other fields will be of paramount interest. It is of vital importance to the marine industry that it be aware of what is taking place in other fields of endeavor and for its own benefit to make use of new improved methods and devices. No radio user can practice isolationism today—all must live together harmoniously within the same radio spectrum.

A few of the radio aids, either developed or improved during the war, are worthy of mention with some explanation. They are:

(1) The conventional radio transmitting and receiving installation which uses the low and intermediate radio frequencies.

(2) High frequency radio transmitting and receiving installations.

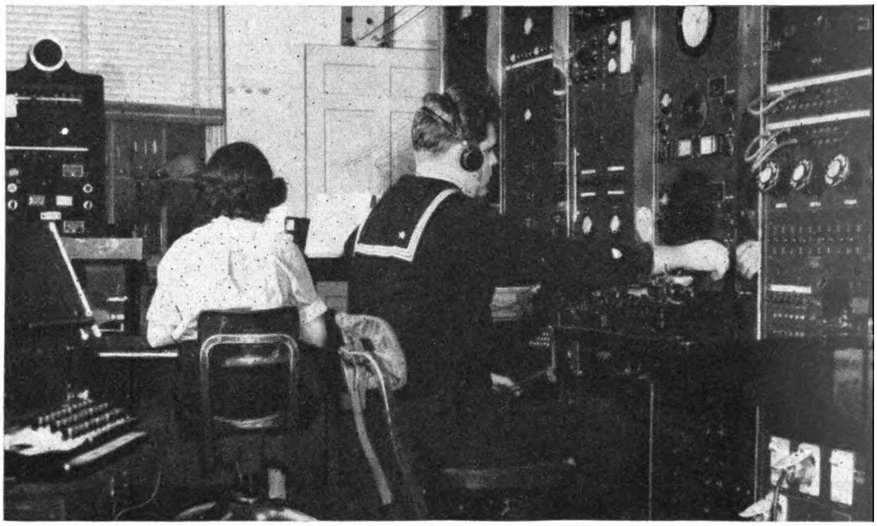
(3) Lifeboat radio equipment.

(4) Loran.
(5) Radar.
(6) High-frequency direction finders and systems.

From the time of the first use of radio on board a ship, the conventional installation has been a transmitter and receiver using the low and intermediate frequencies, centering principally around the distress frequency of 500 kilocycles—which to some of the old-timers means 600 meters. In the early days equipment consisted of the well-known spark transmitters which became outmoded during World War I. In the interval between that war and the Second World War, there was a transition from spark to the well-known modern vacuum tube transmitter and receiver. During this war, improved transmitter and receiver design produced equipment which was more efficient, lighter, and more compact than heretofore—equipment which would better stand the rigors of shipboard use and provide more consistent communications.

No fundamental changes occurred, however, except toward the use of high-frequency communication. The use of high frequencies affords communication over very long distances as contrasted with distances obtained through the lower frequencies. Thus a ship can maintain direct contact with its home country without the necessity for relay through close-by shore stations or other ships. Merchant ship operators during the war demanded this long-distance communication and consequently we now find the majority of seagoing ships equipped with high-frequency radio installations. Shipowners can appreciate, of course, what this means in increased operating efficiency.

Before the war, very little attention had been given to the development of appropriate radio equipn for installation in lifeboats. It is true that mc driven lifeboats on passenger vessels had for s years been so equipped. The available apparatu quired a large amount of space in the lifeboat, was particularly efficient, and left much to be desi As a result of the many sinkings during the war, s means of communication from all types of lifeb became a necessity. Portable, as well as permane installed radio equipment for lifeboats was desig produced, and fitted throughout the merchant ser of all allied nations. An excellent job was don all hands in this respect and this improved r equipment has been the medium through which lives of many survivors of torpedoed vessels have b saved.



OPERATION . . . is more than the turning of a dial. Through this high-frequency control station go hundreds of messages daily concerned with the movement of naval and merchant vessels, the reporting of weather, and the multitude of split-second receiving and transmitting functions of a modern radio control center.

Loran is a system for long-range navigation was born from the necessities of military aviation erations during this war. In short it consists of a work of stations which emit radio impulses. stations are synchronized and operate as a pair. reading the loran indicator, the pilot or ship navig may identify a line of position and by readings f more than one pair of stations a corresponding nun of lines of position are obtained, resulting in a Stations, many manned by the Coast Guard, are in operation in former military areas and along r tary aviation transport routes. While conceived c inally for the benefit of military aviation, it also h direct application to marine navigation, and in has been used to a limited extent. One impor point must not be overlooked, however. In opera over wide areas and as an integrated system, i international in scope and not simply a dom

Therefore, it is very important that the co-ι and contribution of other involved nations ιed in establishing the necessary parts of the In this connection, it is also important that m be so installed and operated as to serve ιs and aircraft flying over ocean routes. Here iation and marine interests must join hands. or the subject of radar. By means of special on board ship emitting appropriate radio : is possible to detect, identify, and obtain of objects such as other ships in the vicinity, ight stations, obstructions, shore lines, etc. rument on board the ship, together with ap-: radio markers on such objects, provides a short range navigational aid system. Its use ticollision device is, of course, apparent, and he mariner has been looking for over the cen-This aid to detection and ranging is one of anding contributions of this war in applied cs. It is now time to lift the veil of secrecy ceed with the development of radar and its on to peacetime uses, especially to navigation r and on the water. Here again, we find that the credit for the development of radar goes who saw its value in solving many problems ing air navigation. With the realization that ne industry did not have access to the knowl-radar's capability and understanding the un-results which might accrue to the marine if wartime radar did not seem to meet their s—the Coast Guard has undertaken to evalu-r from the point of view of its value to ship on and ship safety.

lesire is simply to provide information and s the result of our study of the problem. We ιortly, to lay before you the results of this so that all who are interested in the prob-decide how they wish to proceed in the future. ve agree that the possibilities of radar are sound one note of caution. In my opinion, ld proceed slowly and cautiously, examine the f its use with a critical eye, and be sure that plishes exactly what we want. In all events be well studied from the point of view of its ιe shipmaster and the navigator. He must be ts use and practicability. "New fangled ideas" always received enthusiastically—they must be

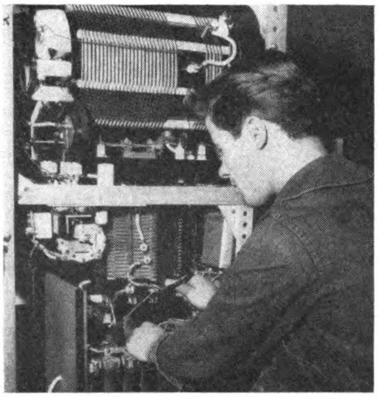
You are all familiar, I am sure, with the : it was many years after the actual develop-the radio direction finder before the majority of navigators and masters accepted it as being of positive value.

I previously mentioned the fact that there are now many more ships equipped with high frequency trans-mitters and receivers, enabling ships to communicate over long distances. With this increased use of high frequencies, not only by ships but by aircraft flying over the water, it is necessary that we re-examine our methods of obtaining bearings of ships and aircraft by radio particularly from onshore. You are, of course, aware of the fact that for many years the Navy and then the Coast Guard have maintained radio direction finder stations along the coasts of the United States for the purpose of taking bearings on ships operating along our coast. This system required that the ship send on its conventional transmitter using frequencies in the intermediate part of the radio spectrum. The radio waves in that part of the spectrum did not give rise to any serious difficulties in obtaining correct bear-ings. In the high frequency area of the radio spec-trum, however, many difficulties were encountered be-cause of the difference in wave propagation charac-teristics. Many of these difficulties were overcome during the war and we now have apparatus which gives fairly accurate bearings. This is a distinct advance in radio direction finding technique, as it enables a shore station to determine the location of a ship or an aircraft at great distances off the coast.

The application of high frequency direction finding to merchant marine shipboard use is worthy of study. While the present apparatus which gives satisfactory accuracy is too cumbersome for shipboard use and there are other technical problems presenting difficul-ties because of limitations found aboard ship, I feel sure all can be overcome when and if a demand exists for such a device. It is on shore, however, that such a facility does have immediate application in that it provides us with an excellent means of locating dis-tressed ships or aircraft at considerable distance from shore, and aids us in effecting search and rescue. The Coast Guard is now operating several networks of these stations. One along the Atlantic and Gulf coast which, together with the Canadian network with which it is integrated, extends from Greenland through the Caribbean area. Another is on the west coast, and extends from California to the western end of the Aleutian Islands. A net well to the west, in the Pa-cific was projected, but has not been followed through because of the war's ending. Because of their ability to take bearings over great range (these networks are able to give substantially complete coverage over a

great expanse of the Atlantic and Pacific shipping and flight lanes. These nets are connected by teletype with rescue centers and while they guard the safety frequencies of 8280 kilocycles they are prepared to switch on notice to any other high frequency that a distressed ship or aircraft may be employing.

Their activities are, of course, confined largely to search and rescue problems, but it would be logical to extend their services to the supplying of general navigational assistance, in the same manner as is now performed by the conventional direction-finding networks employing the lower radio frequencies.

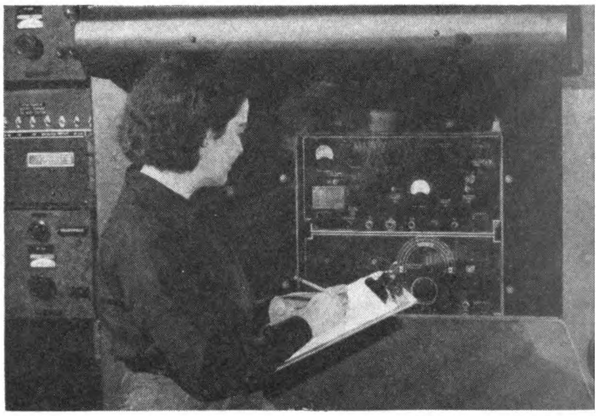


MAINTENANCE . . . requires a "know how" based on a minimum of two to three years of theoretical and practical experience. Here skilled fingers check the thousands of sensitive parts which go into the construction of a modern radio transmitter.

Space does not permit me to give a complete story of how all of these instrumentalities and systems which I have mentioned tie together into an integrated over-all safety system. Each serves a useful purpose and each contributes its share to the safety of ships and aircraft.

The application of electronics, including radio, in all industries is in its infancy. In addition to these systems, developed and produced during the war which have been mentioned here, others will be made known from time to time. They should be discussed and considered in relation to their application to the marine industry. In this connection, I would like to express a word of counsel—that the marine industry take upon itself the job of carefully evaluating all of the electronic and radio devices which have come of this war, or which may be developed in the fu so that it can intelligently assume its part with Government scientists and manufacturers in pro ing adequate and essential facilities.

Marine safety facilities fall into two categori those supplied by the marine industry itself and t supplied by governments as a function of gov ment for the benefit of all. Long-distance direc finder networks on shore and loran fall into the l class. These two systems born of the war ar existence and operating, although an adequate



TESTING . . . along with engineering, research anc velopment, is radio's yardstick of progress. In this hum chamber are tested various types of radio equipment u simulated conditions of humidity and pressure which rately record their reaction under field conditions. Pre up to 30,000 feet, for instance, are recorded in this cha

complete coverage on a world-wide basis has no been achieved. The expansion of these systems, inauguration of new systems, and in fact the contir operation of the present facilities in the pos period cannot be taken as a foregone conclusion. takes money and personnel. Discussions are no progress concerning future policy in that regard. for the recipient of the service which these faci can render to determine whether they shoulc scrapped or maintained.

Former Brig. Gen. Harold R. Harris, present vice president and general manager of AOA, was the first American heavier-than-air pilot to make a chute jump to save his life. Harris was flying a Loening plane at the time, back in 1922.

▼ ▼ ▼

Shark repellent, developed during the war to prevent sharks from attacking flyers forced down over water, has been converted along with other war terials to a peacetime use. Recently just outside G cester the owner of the fishing boat *Angie and Flor* surrounded his mackerel nets by shark repellent i attempt to prevent sharks from ripping the nets destroying the fish. His catch of 58,000 pounc mackerel in comparison to his neighbors' catche 5,000 to 25,000 pounds proved the value of experiment.

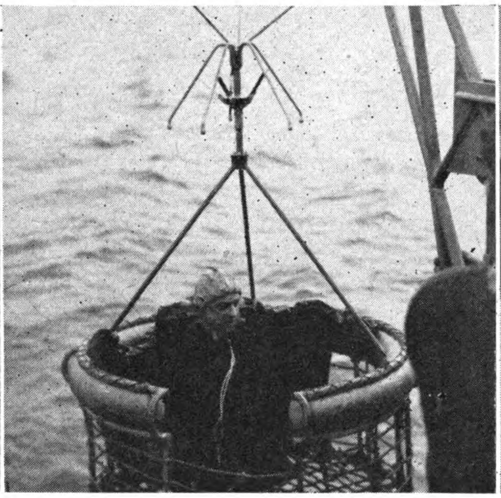
The same four ships again attempted rescue but failed. The men were not recovered.

As a means of assisting in the solution of this problem, Aviation Safety Division of ComAirLant at Norfolk has devised a rescue basket which, under exhaustive preliminary tests, has proved highly promising.

The basket consists of a circular steel frame, the bottom and sides of which are covered with a rope net. A small opening for boarding is cut in the side. A canvas-covered kapok ring circles the top of the basket

escue
asket

sket with board. Note vith weight imately 400



Rescue basket and retrieving device. Note pear-shaped retriever and preventers on grapnels.

The rescue basket being hauled aboard an AVR, using davit and winch.

the greatest problems of surface ships en- rescue work is boarding a survivor—especially one—in a rough sea. The ship's roll and can cause him to be dashed against the hull es alongside; or rebounding waves may throw a considerable distance from the ship.

ample of such rescue work occurred a few go during carrier qualification landings in tic area. A plane went over the side and pant was seen to get clear of the craft; his t inflated and he appeared in good shape. s attempted rescue but due to the roughness , their efforts were in vain. One ship put a the side but in a couple of minutes he was ack to the ship suffering from shock and ex- The distressed aviator was last seen going keel of the fourth ship in a helpless condi- hour later another lad went over the side.

so that it floats in a partly submerged position. Three steel bars pyramid above the basket, with a ring on top to accommodate a grappling hook or line. The entire unit is collapsible for convenient stowage.

The rescue basket is lowered over the side with tow line attached and is dragged slowly past the survivor. If he is helpless, a member of the ship's crew may be lowered in the basket to aid him. The survivor can board the basket effortlessly through the side opening and is then towed back to the ship and the entire unit hauled up by crane—an operation requiring but a few minutes.

Actual open-water tests were conducted in Chesapeake Bay in late August 1945. Participating in the tests were the U. S. S. *Chatelain* (DE–149) and two 65-foot rescue boats from the Naval Air Station, Norfolk, and the Coast Guard.

Although moderately rough water (Beaufort 4) prevailed each day at the hour of sailing, by the time tests were well under way, the sea was relatively calm (Beaufort 2 or 3). It is planned to repeat the tests under wind conditions more nearly approximating those of winter weather (Beaufort 5). The purposes of the tests were:

(*a*) To evaluate the Bathy-Thermograph boom as a rescue device in hoisting men or rescue equipment aboard from the water. The boom was also evaluated from the standpoint of enabling rescue crews to handle the larger pieces of rescue equipment such as: Rescue basket and Stoke's stretcher with despatch, making it possible to have this equipment in the best position possible for rescue.

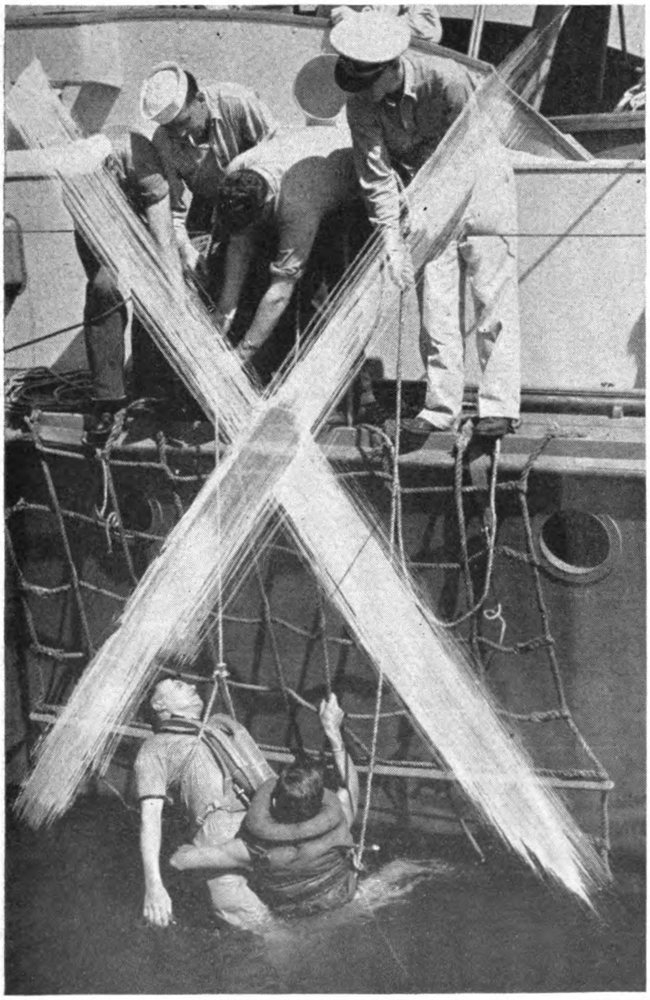
(*b*) To test the experimental rescue basket as a device for rescuing men from the water under ing conditions; i. e., men swimming and able sist themselves, men in life rafts, injured men, an suffering from exposure and unable to assist selves. Tests were also conducted using the bas free thrown rescue device similar to a life ring a a towed platform for rescuer to intercept and a helpless victim.

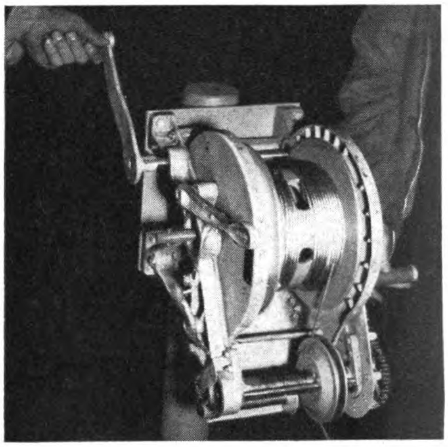
As a result of these tests, it was reported that:

1. The Bathy-Thermograph boom greatly inc the facility of bringing men aboard in rescue tions.

2. The Bathy-Thermograph boom operated great efficiency when used in conjunction with t perimental rescue basket, the floating Stokes str and the Erickson modification of the Mae West.

Conventional method for hauling helpless survivors aboard AVR, using cargo net and many hands in a limited working space.





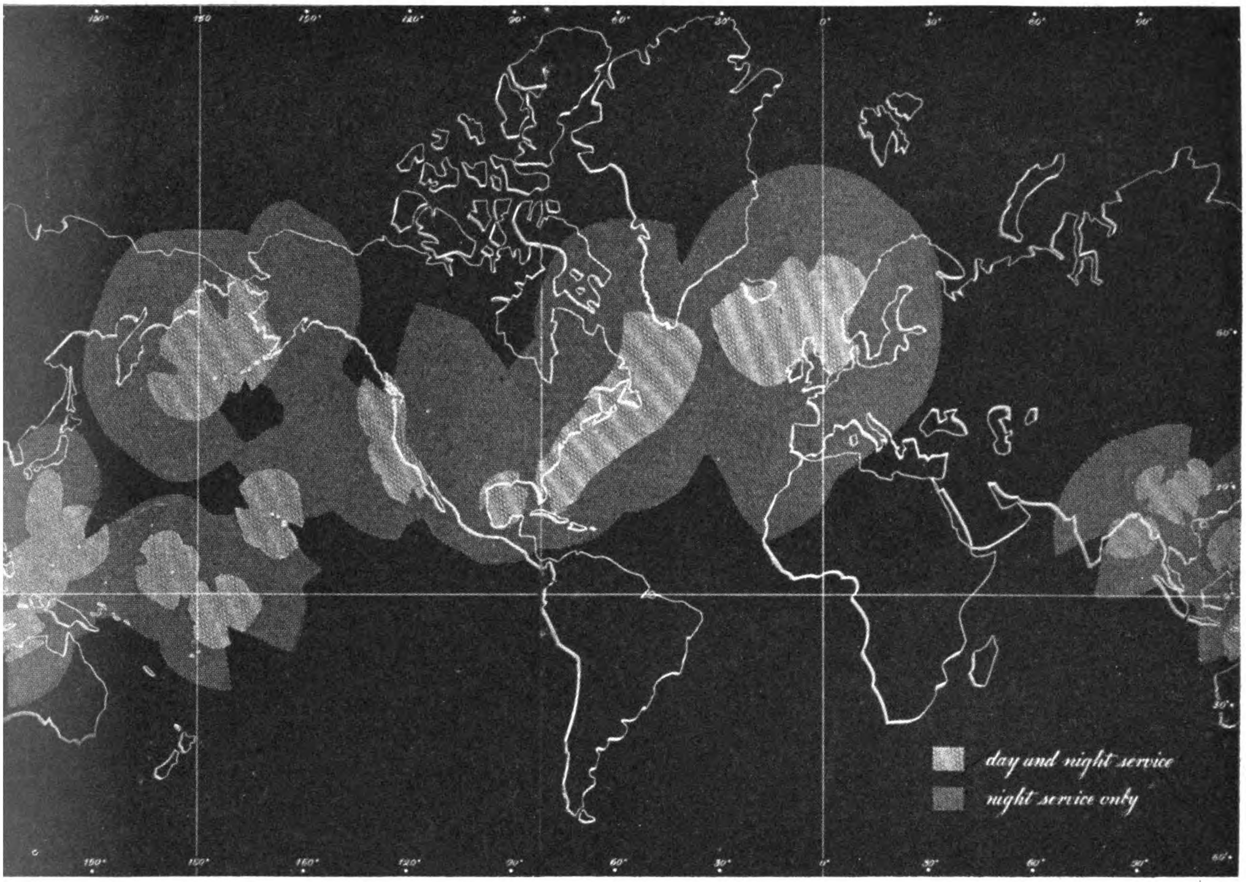
Modified PBM anchor winch used with the rescue basket. Easily operated by two men.

3. The experimental rescue basket is a pr piece of rescue equipment.

a. The rescue basket is an excellent device for ing men aboard from the water who can or assist themselves.

b. In emergency the rescue basket can be t free of the ship to the assistance of men in the And recovery of the basket is accomplished with greater ease than recovering men direct.

c. The use of the basket by towing and para is questionable under the conditions which make the technique desirable. It did work s fully in test with light wind and sea conditions.



LORAN

NG RANGE NAVIGATIONAL AID

var has accelerated the development and use electronic devices for which there are prac- plications in the postwar world. Loran—a ble radio system of long range navigation—is hese. As a navigational aid to aircraft and is unique in providing a means of quickly ırately ascertaining geographical position over ances, regardless of weather conditions.

us radio navigational aids have depended ne form of direction finding; that is, they have by determining the direction from which the ves reach the receiver. Because of this, and the direction of radio waves is subject to un- ole vagaries of propagation, the previous radio avigation have not reached, after 25 years of development, a high state of dependability. lay, occasional accidents are caused by failure or receiving apparatus to provide true indi- position. Loran avoids dangerous vagaries ıgation, and if signals and interfering noise are such that readings can be obtained, they will be dependably accurate readings. This is a most important point, because it means that for the first time in the long history of radio navigational aids, one is now presented which can be depended upon never to give false indications. In addition to greater dependability, the useful range of Loran is greater by far than that of direction-finding methods.

An important characteristic of the Loran system is that it utilizes pulse transmission, rather than continuous waves. This is basic, because pulse systems measure time of travel of the signals, whereas continuous transmission can not do so, and must utilize direction of arrival of the signals, or their phase differences. Speed and time of travel of radio waves are much more stable and reliable than their other propagation characteristics, so that pulse systems have this fundamental advantage. There are other advantages in pulse systems also, which make it appear certain that future developments in technique will provide great improvements in systems using pulses.

These three characteristics of Loran will greatly increase the importance of radio aids relative to other navigational aids and methods, and are likely to revolutionize navigational practice within a few years.

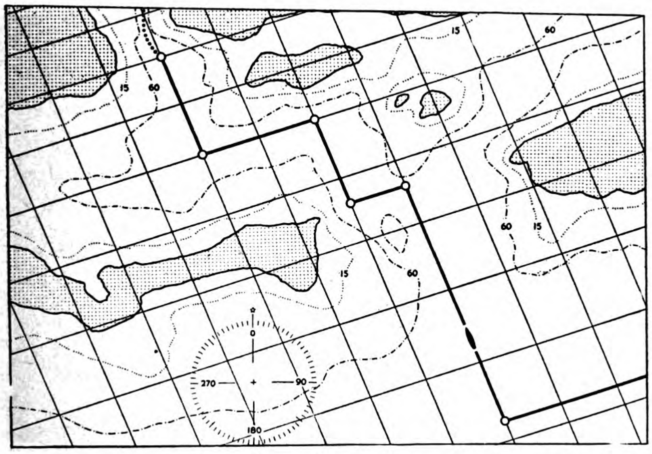
Often it has been considered that knowledge of accurate position is not especially useful to surface ships

at long distances from shore, and that such knowledge is important only when they approach coasts. However, there are cases where accurate long distance navigation is very useful, even to surface ships. One such case is that of rendezvous between air and surface craft, particularly in areas where visibility is poor. Furthermore, economy of operation is furthered in every case by maintaining the shortest possible tract in every cruise.

The greatest usefulness of Loran is to aircraft on long flights over water, because under weather conditions unfavorable for celestial observations, it assures sufficiently accurate navigation to bring the aircraft within range of local radio navigational aids at the destination.

Transport aircraft assured of exact position at all times during flight can reduce the amount of reserve fuel from that ordinarily carried. Less fuel means more pay-load. Actual cases observed recently have ranged from 200 to 1,000 pounds increase of pay-load.

The distinctive features of Loran may be summarized (as presently used, disregarding developments now in laboratory stage and known to provide great improvements):



An example of Loran's application to piloting upon approaching a land-locked harbor.

1. It can obtain accurate fixes out to 600 to 800 miles from the transmitting stations in daytime and 1,200 to 1,400 miles at night, with accuracy comparable to that of good celestial observations.

2. It is almost completely independent of weather. It works during the most adverse weather, in rough sea or air, and under all conditions except that of extreme precipitation static. When successful anti-precipitation static devices become available, this limitation on Loran will be removed.

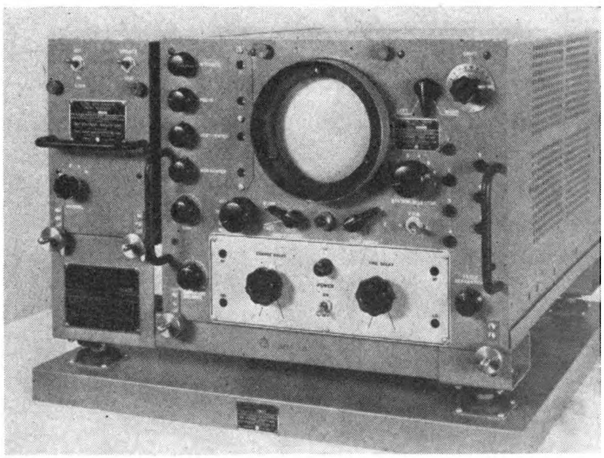
3. No transmission from the plane or ship required.

4. Fixes may be obtained by a skilled operatoı about 2 minutes. No calculations are necessary.

5. Fixes are not dependent upon compass, cł nometer, or other radio or radar sets; special Lo equipment is used, which, for aircraft, weighs fı 35 to 70 pounds depending upon model used.

HISTORY OF LORAN

Loran was developed by the Radiation Laborat of the National Defense Research Committee. first tests, conducted in 1942, were successful, the Navy Department immediately made arrar ments with the National Defense Research Commi to introduce the system into war service, and to stall the first stations as quickly as possible on northwest Atlantic coast. These first stations, se in number, were erected in 1942, using laborat built equipment. The Radiation Laboratory has c tinued work on development and improvement of system, radio manufacturers have taken up prod tion of the equipment, and the armed services ins and operate it. Since the War Department was in ested, the project was adopted by the joint chief



Loran Shipboard Receiver.

staff and joint plans were set up for its introduct Chief among these was the list of priorities of aı to receive service, because immediate equipment ı duction was limited. The North Atlantic was gi first priority, and the North Pacific second, beca these bad-weather areas most needed a navigatic aid independent of weather.

Additional areas were subsequently included, most recent of which are in Europe and in Pacific. The system as it exists today is an effec

th nearly complete coverage of the world's and ship lanes.

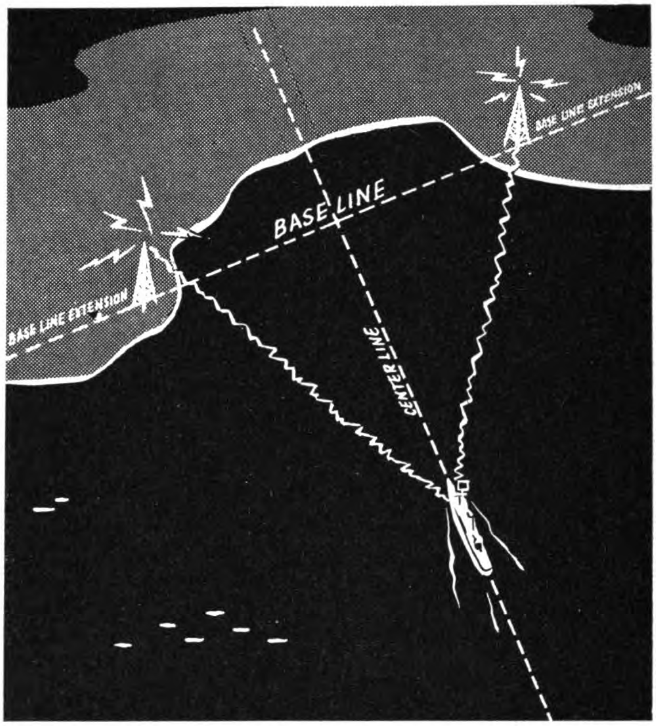
942 the joint chiefs of staff assigned to the)epartment the development, installation, and on of ground stations to give Loran service, shipboard receiving apparatus. Cognizance aft receiving apparatus was given to the War nent. This division of the project was made l duplication of effort, to maximize production cy, and to assure standardization of equipment. sult, the same receiving equipment is used by and Navy aircraft, and one system of ground serves the requirements of both.

of the stations in operation have been installed, operated, by the United States Navy (Coast . One group in the northeast Atlantic is op- by the Royal Navy, one in Europe by the Royal ce, one in the northwest Atlantic by the Cana- avy, and several in the southwest Pacific and areas by the United States Army Air Forces.

ie end of 1945 about 30,000 aircraft and 3,000 ships will have been equipped with Loran s. Installation of the system is now world- d services using it include USN, USAAF, RN, RCN, RCAF, RAN, NATS, ATC. Important onal use of the system is being had in Europe, intic, Pacific, and the China-Burma-India area. r the future, it is clear that a system of depend- ng-range radio navigational aid is required, rld-wide basis. If the system has the accuracy, ty, and homing-line-of position facility that has, very great increases in both safety and effi- of navigation will be brought about.

V EVOLVED FROM TELEVISION

n is one of the many current radio and radar which evolved from television. Television e radio art new instrumentalities, one of which eans of reproducing electric currents visually— en rather than heard. This is important be- he eye can be used for accurate quantitative and the ear cannot. Second, television tech- rovided radio frequency circuits of new kinds, lity of which is that of controlling electric forces treme time precison. These circuits make it to measure time intervals of fractional parts of nth of a second, or to control forces at a distance e same time precision. It therefore became to measure the time-distance-velocity relation- radio waves, even though they travel nearly



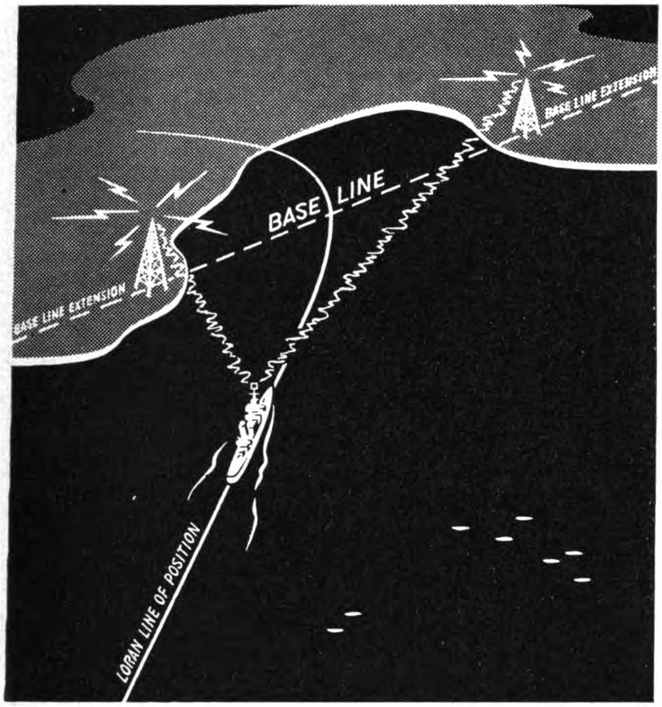
If two stations, A and B, are sending out pulses of radio energy simultaneously, they arrive at any point on the center line at the same instant. Therefore a ship or plane receiving a time difference reading of zero would be somewhere on the center line. It has therefore established its line of position.

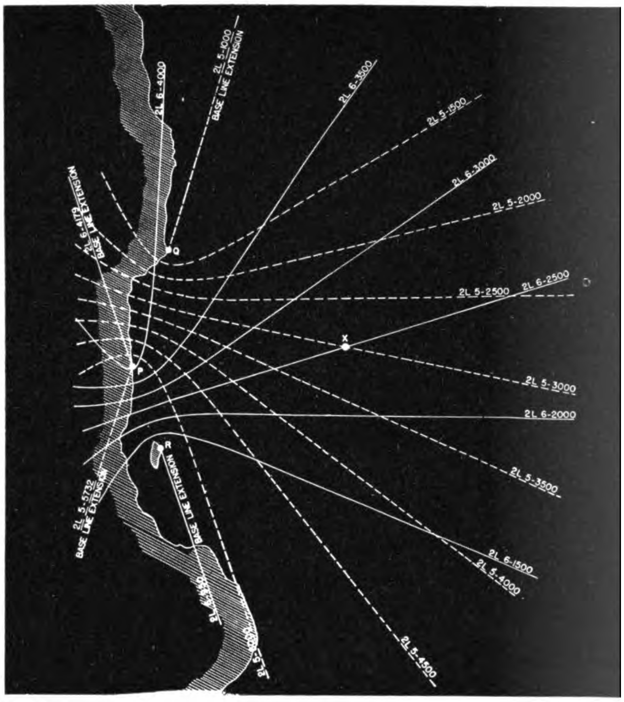
200 miles in one one-thousandth of a second. All of the new radar devices utilize the new ability to measure or to exhibit the relationship between distance and travel time of radio waves, in one way or another.

EXPLANATION OF OPERATION

The Loran system uses a number of ground stations located to cover the area to be served, and a single receiver aboard the ship or aircraft, connected to an ordinary radio antenna. In effect, the system measures the times of travel of radio waves from two ground stations to the ship or aircraft, and deduces distances from these times. It does not depend upon the directions from which signals come, but upon the difference between times of pulses arrival from two stations. From 1 to 2 minutes time is required to adjust the receiver and take the readings which provide a position fix.

The accuracy obtainable varies with several factors, but in general can be considered as giving positions within 1 percent of the distance from base stations (10 miles at 1,000 miles). Actual reports from ships using the system during the past year show the ma-





A ship or plane which receives the pulse from station A earlier than the one from station B by a certain amount is somewhere on this line of position. This line of time difference is a hyperbola around station A. (Right) Two lines of position from two pairs of Loran stations provide a Loran fix. Station "P," centrally located, is the "Master" station common to both "Slave" stations. The position, "X" for example, is obtained by reading on the ship's Lor receiver the time difference of signals between master "] and slave "Q," and then the time difference betwe master "P" and slave "R." Each reading represents o line of position and the intersection of the two lines is t ship's position. Special Loran charts are supplied f the area served by the stations, which show the lines position for that area.

jority of readings to be well within 1 percent. Skill in operation is required for high accuracy at distances over 600 to 800 nautical miles, where sky waves must be used, and the accuracy obtained increases markedly after a few weeks' experience. Along the "baseline," between transmitting stations, the lines of position are extremely accurate, so that at such points very accurate landfalls are possible, and harbors can be approached with a precision of a few hundred yards.

LORAN'S APPLICATION TO NAVIGATION AND PILOTING

The fields of application wherein the Loran system can provide service not possible or practicable with other devices, include those requiring knowledge of accurate position at any time during long trips, especially tranoceanic flights. It is perhaps true that surface ships, when far from shore, rarely need more accurate knowledge of position than that given by older methods of navigation; but the installation of Loran equipment in all large ships is desirable as contributory to safe and economical operation.

In cases of distress at sea, the contributions of Loran are twofold. It provides in a few minutes the exa position of the ship, and both geographic and Lor: coordinates may be appended to the call for assistanc Furthermore, it provides the rescue ship wi knowledge of its own position, which may not be know accurately if recent celestial observations have not be possible. The rescue ship therefore can find the sh in distress using Loran coordinates, even if neith ship knows its position by other methods.

A practical application—now in use by ships ar aircraft equipped with Loran—is that of piloting "homing" to a harbor. Using it, the plane or ship able to reach harbor channels at full speed, with ce tainty, even when position fixes by other methods ha been impossible for long periods while approachi the coast. Each spot on the coast, harbor, buoy, ar airfield, has some Loran line of position runni through it. The particular line passing through a desired destination is determined from the Lor: chart. The ship or aircraft approaching the co: merely navigates, well off shore, so as to reach th particular line of position, as read on the Lor:

Having reached that line, the Loran re-
emains on the setting for that line; and the
eered so that the Loran receiver continuously
nds to that setting. If the ship veers right or
n its course, the indicator will show the
immediately. The ship is maintained on a
hich is the charted Loran line of position and
ily arrives at the desired destination. The
of the maintenance of ship's course is that
Loran system—which, when close to a coast
h stations are located, is a very few hundred

OF RECEIVING EQUIPMENT

esent the aircraft receiver is the lowest cost
d its cost is about $700 (neglecting down-
negotiation which is likely). In the immediate
period, aircraft and ship receivers could be
ctured in moderate quantity, to sell for $400
Still lower costs are likely, with simplified
possible with further development.

OPMENT REQUIREMENTS AND BILITIES

present Loran system, while now providing
and valuable service, has certain deficiencies
hould be removed to make it a permanently
ory postwar service. These are:

)aytime range only 600 to 800 nautical miles,
nighttime range is 1,400 nautical miles.

Nighttime operation utilizes skywaves which
as stable as ground waves and which require
ill on the part of the operator for proper
ation.

Receiving equipment operation requires some
valuate readings numerically after the settings
en made.

The service area of 1 chain of 3 stations is only about 1,000,000 square miles, is effective only over water, and about 150 stations would be required to provide service over all the important overwater airways of the world.

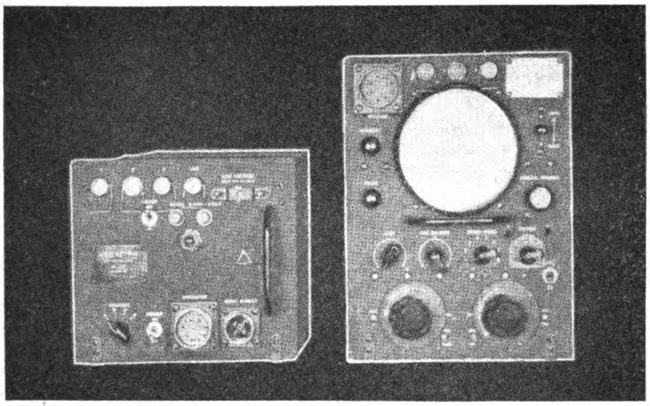
(*e*) The apparatus now used is built under the designs developed when the system was new and is more complex than necessary.

Laboratory work and field tests, now under way and well advanced, show that the above-mentioned deficiencies can be removed. The daytime range can be increased to 1,000 to 1,500 miles under severe noise conditions, and 2,000–3,000 miles under light noise conditions. The use of unstable sky waves can be avoided. The accuracy can be increased to within 1 or 2 miles at 1,000 miles from stations. Receivers are in production which are direct-reading, that is, no skill is required to take readings. The service area of each new Loran system chain is about 5,000,000 square miles, and only 60 or 70 stations will be required to give good coverage over all important land and water airways of the world.

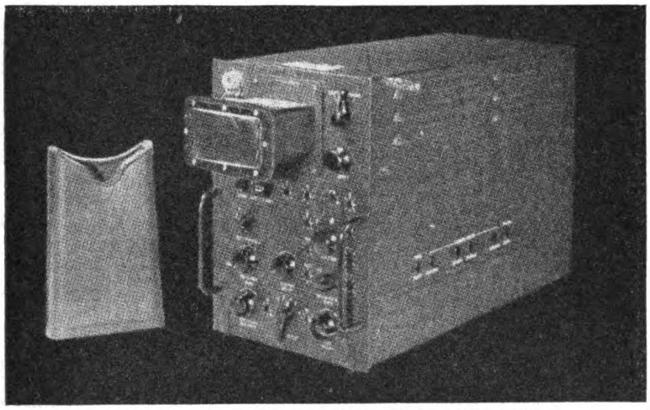
CONCLUSION

The salient characteristics of the Loran system, viewed from the postwar application angle, are as follows:

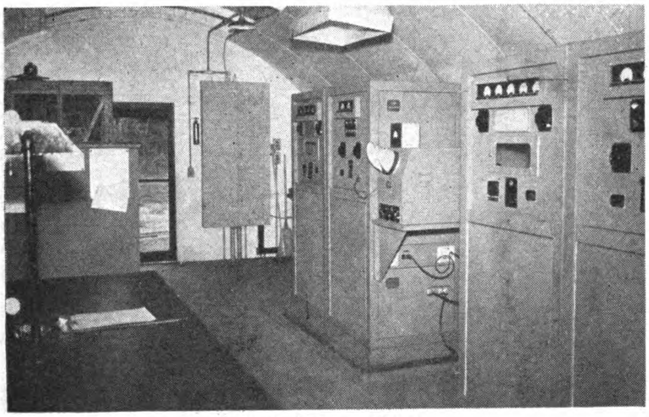
1. Range 1,000 to 3,000 miles (dependent upon noise conditions).
2. Stability, reliability, and accuracy very high.
3. Receiver cost in first few years under $500.
4. Aircraft receiver weight—now 35 pounds.
5. Approximately 70 stations required for world coverage.
6. System fundamentally sound and therefore susceptible to continued improvement with future development. For example, direct reading receivers now in beginning production demonstrate that by



Loran Aircraft Receiver—Current Model.



Loran Aircraft Receiver—New Model.

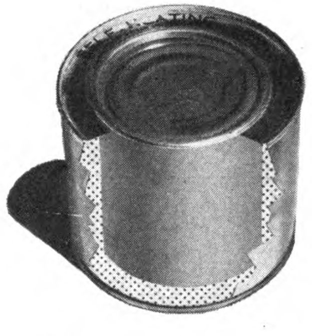


Loran Transmitter.

relatively simple connection to aircraft automatic pilots, automatic steering of aircraft will be possible.

7. Used in conjunction with two other wartime developments, namely the radio altimeter (for altitude), and radar (for short range navigation and obstacle detection) the Loran system (for long range navigation) completes the requirements for navigational aids and provides all that is necessary for safety and efficiency of navigation.

8. The same system, using the same stations, can serve both aircraft and surface vessels.



SELF-HEATING RATIONS

The hot cans used in Self-Heating Rations v designed for providing food on large cargo airc and for personnel in isolated field positions. The assembly consists of a central can containing 1 fluid ouces (M units of Field Ration C). Surrou ing the sides of the central can is a container for heat-producing substance *illustrated by the do area*). The contents of the central can may be he by adding a total of 40 ml. of water to the outer This is the equivalent of ⅛ canteen cup of water. water should be distributed equally through eac four holes evenly spaced on the bottom of the c section of the can assembly. The can assen weighs approximately 25 ounces gross, when full, has a cubic displacement of approximately 50 c inches.

SHEPHERDS OF SOUTHERNKNOWE

In the rugged country separating England Scotland, Col. Eugene A. Romig, representing the Air Force, and Sir James Ross, of the British Ministry, recently honored the shepherds of So ernknowe for their part in rescuing British American airmen who had crashed in the moun of Cheviot during the war. These shepherds, onl habitants of the lonely Cheviot area, are credited saving many lives of airmen who crashed or forced down in bad weather.

On one occasion in December 1944, Sheph John Dagg and Frank Moscrop, went out in a bl ing snowstorm and in almost impossible conditio rescue four or six Americans whose B–17 had cras For this act the shepherds were presented with 8th Air Force scroll and the British Empire M Dagg's collie dog, Sheila, who found one of the jured airmen more than 150 yards from the wreck was presented with the Dickins Medal to become first civilian dog to receive this award.

graphic Signaling
ɔrs

(*Continued from page 29*)

merely the average rate at which flashes of ·ere received by the plane from each signal- ·:

	Average number of flashes observed per minute
ıed foresight aiming method	0. 3
-steel foresight mirror	8
:d-glass, rearsight (G. E.) mirror	14
lector (Signal Service Corp.) mirror	35

ıe results it is apparent that the retroreflector-ɔr performed most effectively, while the im-ɔresight method was poorest. The stainless-ight and General Electric rearsight mirrors mediate in effectiveness.

ı the retroreflector-type mirror definitely gave performance during signaling, it was not superior to other mirrors in the ease :h the subjects learned to use it properly. trouble which the subjects encountered in :o use the new mirror resulted from their discover that it is necessary always to face :flector roughly toward the sun before it pro-isible red spot for use in aiming. With the leveloped Scotchlite-type signaling mirror, ulty with aiming has been eliminated, so ıat the newest device is superior to anything heretofore been used for mirror signaling.

ɔNCLUSION

liographic signaling mirror is a small, inex-et effective signaling device; however, it has s. Naturally it will not work when the sun clouds. In addition, it cannot be used to ıals at angles too far from the sun. Each :thods of aiming described above gets more › use as the angle between the sun and target r than 90°. The retroreflector type mirrors ork at angles greater than about 135° because :eflective materials cease to function with lent on them at more than 65° or 70° from Even though flashes cannot be aimed in more than 135° from the sun, signals can :ss be directed to every part of the sky when more than 45° above the horizon, and they ıt to all but a small segment of the sky when lower.

:troreflector-type mirrors, there is a cone of immediately surrounding the sun into which signals cannot be aimed. The existence of this cone of directions is due to the necessity for lateral travel of the aiming beam within the mirror from the retroreflector where it starts to the sighting hole. (See figs. 4 and 5.) When sunlight strikes a mirror perpendicularly, there is no lateral travel of this beam. In practice, this cone of directions in which the aiming mechanism does not operate is from 20° to 30° in diameter with the sun as its center. However, it covers only a small fraction of the total area of the sky and the user of a signaling mirror can easily hold this area to a minimum by remembering to move his eye to the side of the sighting hole opposite the sun and nearest the target.

In spite of limitations, the new retroreflector-type signaling mirrors seems well worth placing on all American ships and overseas aircraft along with the other best items of survival equipment developed during the war. It may be expected that the new device will also find use by surveyors, mountain climbers and other persons engaged in outdoor activities. Forest Service officials have expressed interest in the mirror as a possible device to use in signaling between airplanes and crews on the ground.

To enlarge its possible usefulness and to improve it as an air-sea rescue device, a method has been developed to obtain red, yellow, and green signals from a signaling mirror which are readily distinguishable from each other and from the usual achromatic signals. To obtain each of these chromatic signals, a film of red, yellow, or green cellulose acetate film was held in front of the mirror. A hole was cut in each film to coincide with the aiming window. This film was purposely held so that its surface was not parallel to the mirror surface because it was found that the achromatic reflection from the front face of a film could seriously dilute the color of the signal reflected by the mirror. By making the film nonparallel to the mirror, the beam reflected from the front surface of the film was thrown harmlessly to one side of the aimed beam.

There is a question whether the best signaling mirror for survial use is one which gives a distinctly chromatic (red or orange) signal or one which gives a plain achromatic signal. A red or orange signal is more likely to attract the attention of the casual passer-by than an achromatic signal. However, the greater complexity of the device which gives the colored signal may offset the advantage of color. In general, apparatus for survial use should be as simple and foolproof as possible.

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Ketchikan, Alaska


Source of icebergs and their drift into the North Atlantic. Fully 90% of the icebergs that drift south of the 48th parallel each year, disintegrate in the melting area (shaded area at junction of arrows) which covers some 74,000 square sea miles. Principal sea routes that traverse the ice patrol areas are indicated by white lines A, B, C (to and from U. S. ports), and D, E, F, G (to and from Canadian ports).
GREENLAND
Labrador Current
NEWFOUNDLAND
St. Johns
G
F
E
C-D
D
B
A
50°
40°
60°
50°
Stream
ATLANTIC OCEAN

Air Sea Rescue bulletin

APRIL

NAVCG 128, Vol.

Air Sea Rescue bulletin

ıformation contained herein is assembled from various United States and foreign sources; isseminated in this BULLETIN for information only to a limited list of addresses with ıt in the field of air-sea rescue. It will be apparent that the BULLETIN may contain ıation which does not represent the policy of the Air Sea Rescue Agency or the Services ented on the Board for Air Sea Rescue.

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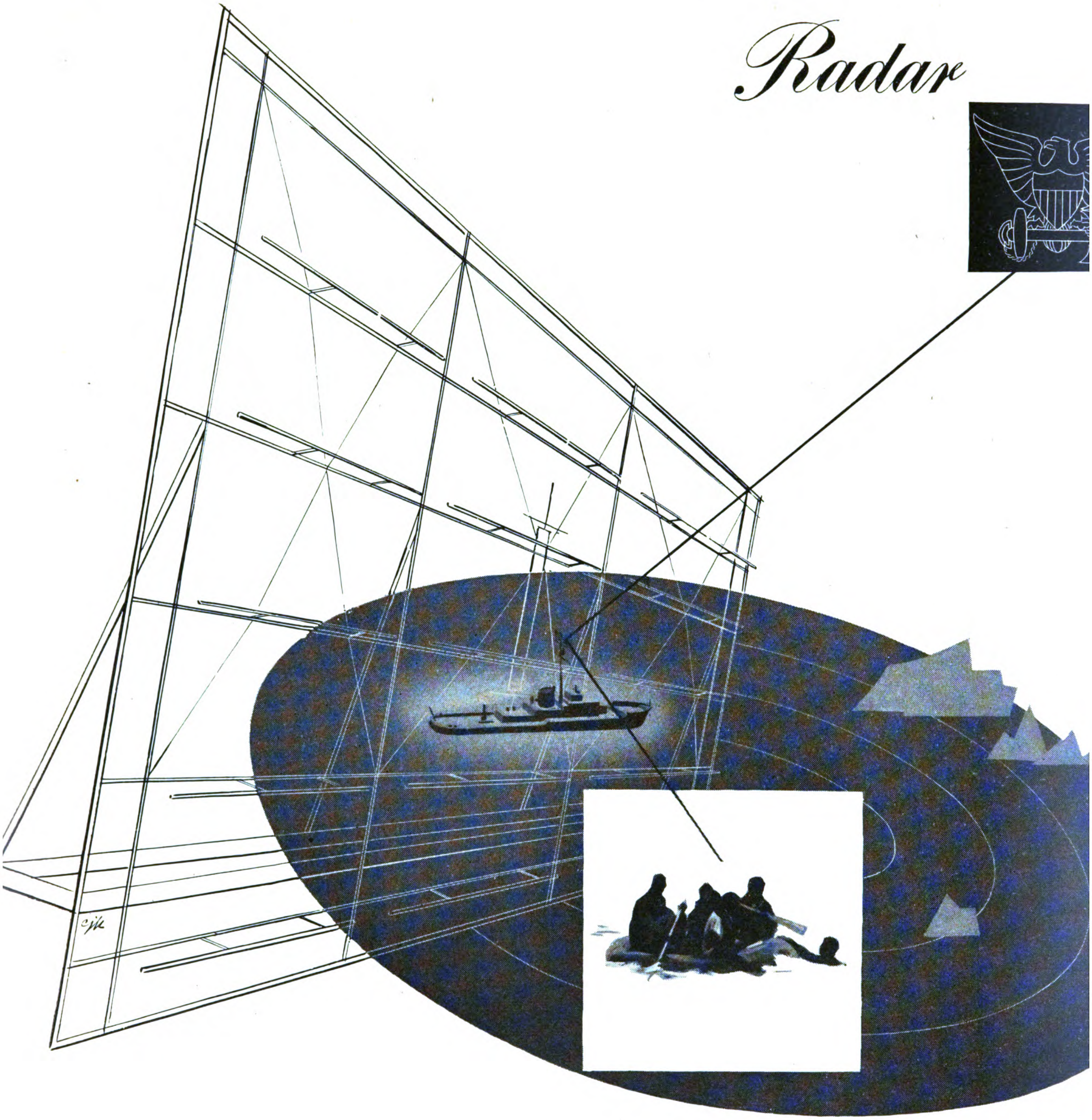
LISHED MONTHLY BY THE U. S. COAST GUARD FOR AIR SEA

ʼUE AGENCY, 1516 14TH STREET NW., WASHINGTON, D. C.

THIS MONTH'S COVER

Symbol of the achievements of United States military and naval scientists in the field of electronics, is this Army Signal Corps photo of the radar unit which figured in the Signal Corps' historic radar contact with the moon

Radar



The following article is based on material prepared by the United States Coast which, because of its traditional function of saving life and property at sea, has undertaken extensive research in the field of electronic navigational aids. It is beli this nontechnical story presents sufficient facts for a broad evaluation of radar's pote tial as a practical maritime safety factor. Space does not permit an exposition of its probable value in other fields, nor does it permit of an adequate acknowledgment work of United States Army and Navy scientists whose achievements in the field radar are a challenge to man's imagination.

684235—46—1

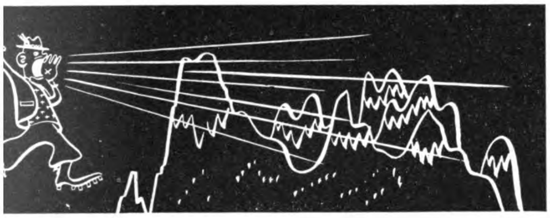
ıg before President Truman—at the Potsdam onference—gave approval for the release of ecrets to the American people, the Navy and ;uard recognized its potential as a safety factor peration of merchant vessels. This recognition ed upon a comprehensive wartime experience. /ed before the war, but crystallized to practical war's impact, radar promises to be one of the nportant single contributions to the safety of ea. It can reasonably be expected that radar will be as common on a vessel's bridge as the mpass.

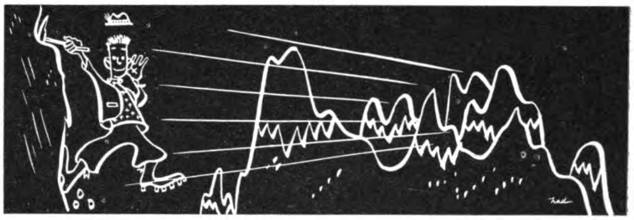
ır seems to have experienced almost simultane- :h in many parts of the world. Its basic con- as the result of independent thinking on the many persons who believed the pulse tech- :ould be used for detecting and ranging such as ships and planes. Scientists in America,

In 1935, Congress provided a fund of $100,000 to the Naval Reseach Laboratory for radar development work. A rather crude unit was successfully tested in 1937, aboard the U. S. S. *Leary* and, in 1939, a greatly improved unit underwent extensive trials at sea aboard the U. S. S. *New York*. Other experimental efforts between 1935 and 1939, conducted from the ground, employed a variety of ships and aircraft and the dirigible *Akron*.

Probably no other scientific or industrial development in world history so expanded in all phases simultaneously, or on such a vast scale, as did radar, Research, development, design, production, test, and the training of thousands of operators and installers—all of this was set up on one vast scale for simultaneous projection . . . and, significantly, the use of radar by land, sea, and air forces was so widespread that nearly every commanding officer had to be edu-

mplest form, Radar can be understood as working on an echo principle. The time interval between echos indicating distances.





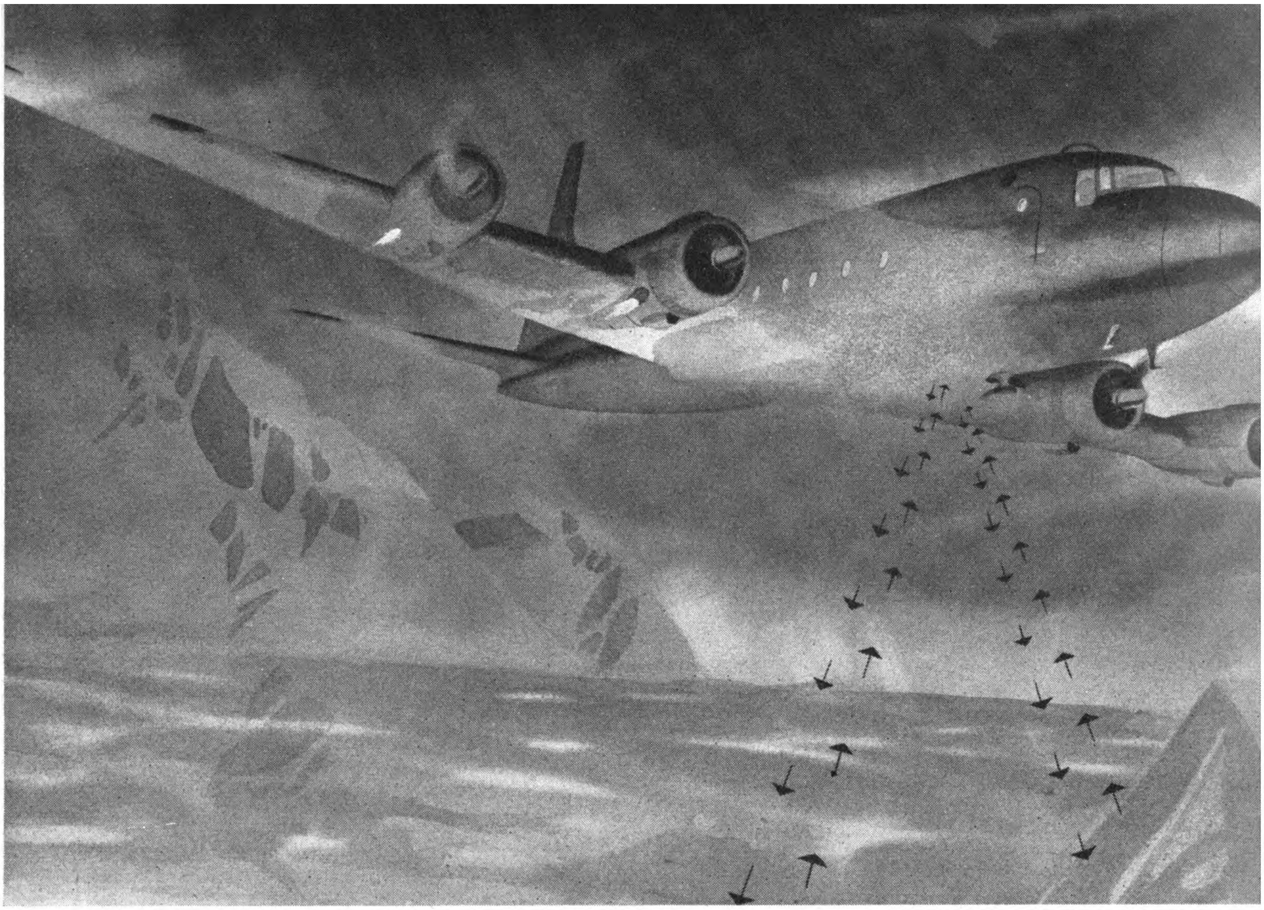
d, France, Germany, and perhaps Japan, secretly and independently on problems of ed power output, shorter pulses, directional a systems and many other practical phases.

name Radar is derived from *Ra*dio *D*etection anging. Its basic principle is comparatively Experiments conducted in 1886, proved that waves are reflected from solid objects. In everal countries granted patents to a German ər for an obstacle detector and navigational ships, based on this principle.

discovery which led to the actual development ır was made in 1922, by two scientists working Aircraft Radio Laboratory in Anacostia, Md. testing plane-to-ground communications, they :d that ships moving in the Potomac River dis- the pattern of radio waves, causing a fluctuat- nal.

cated to appreciate the capabilities and limitations of this dramatic new weapon being placed in his hands. Thus, having gained this appreciation, field officers had to work out the tactical employment of radar, through the trial and error method, and to communicate this knowledge and experience to other field commanders. It was a task made doubly difficult by the requirements of secrecy which surrounded radar's wartime development and use.

While the war lasted, radar was strictly under military control and was employed only by the armed forces. However, because of its potentials for service to the maritime industry, the Coast Guard began an exhaustive study of radar and its possibilities for peacetime use. The Coast Guard Cutter *Mackinaw* was radar-equipped especially to study conditions in the Great Lakes region. Later, other vessels and planes were so equipped for studies in other regions



Radar-equipped planes above the clouds can determine the nature of the terrain below.

and under varying conditions of operation. Radar units were installed on harbor craft to study its possible value for harbor work. Its worth in collision prevention and as an aid to navigation was quickly proved. In 1945, in order to coordinate rapidly expanding radar activities within the service, and to accumulate new data, a radar study group was established by the Coast Guard.

With the arrival of peace and a consideration of the postwar application of radar to an expanded maritime industry, came the need for establishing minimum standards of design and performance. Simplicity of design and operation, economy of production and maintenance, are objectives of the long range program undertaken by the Coast Guard.

In carrying on this program, consideration is being given to the experience and knowledge gained during the war, to the large quantity of surplus radar equipment presently available, to the possible coordination of merchant marine radar with present and future navigational aids, and to the possible effect of such merchant marine radar installations on navigational laws and insurance rates.

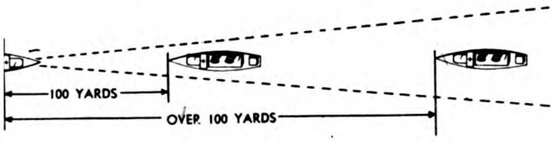
Three sets of minimum specifications were pre with the cooperation and assistance of the Na the Radiation Laboratory, and submitted to a c ence of radar manufacturers and representat the maritime industry, out of which came a set of standards. These provide the basis for jected commercial radar production program will make available to the maritime industry a system that will contribute immeasurably to the of life and property at sea.

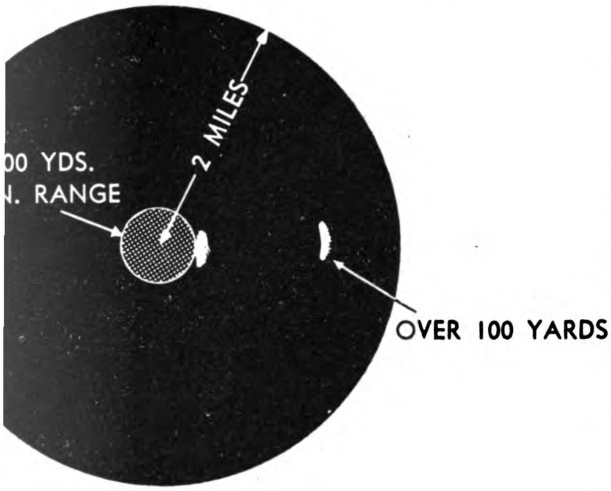
TECHNICAL DESCRIPTION

Developed primarily as an instrument to b for detecting and ranging in warfare, radar to detect land, vessels, buoys, and other objects the surface of the water, within the range equipment; improvement of initial designs pr for baring determination. The methods used present time limit the minimum practical range proximately 100 yards and the maximum slightly more than the line of sight. Althou electronically-received information may be pre on the radar receiver by different methods, th

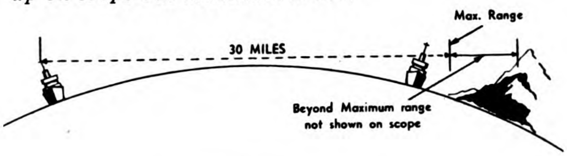
osition-indicator) is operationally the simplest which produces a polar chart of the immerea surrounding the vessel from approximately ard radius to the horizon. Such a device is wer to a mariner's dream. It is independent or night, and relatively independent of weather mospheric conditions, while providing a cons plot for both fixed and mobile objects. Un-

tic sketch illustrating minimum range. Any object han the minimum range would not be picked up.





atic sketch illustrating maximum range. Ship is up on scope but mountain is not.



fortunately, radar has limitations as well, and in order that a clear picture may be presented as to what this device will accomplish it is well to proceed initially with an explanation of the equipment.

Basically radar employs very short electromagnetic waves and utilizes the principle that these waves can be beamed, that they travel at a definite speed in a straight line, and that they will be reflected from any discontinuity in the medium through which they are transmitted.

The typical surface radar consists of five components, the transmitter, modulator, antenna, receiver, and indicator. In addition to these components, power supply is an important factor to be considered in determining the actual characteristics of any radar set. While the physical form of each of these parts may vary widely from one type to another, all radars contain them.

THE TRANSMITTER

The transmitter consists of the radio frequency oscillator which produces the electromagnetic waves of energy. Because of the necessity for beaming this energy, while at the same time being able to receive suitable echoes, the oscillator generates very high-frequency energy. The development of a suitable oscillator with sufficient power has been one of the major accomplishments of radar technicians.

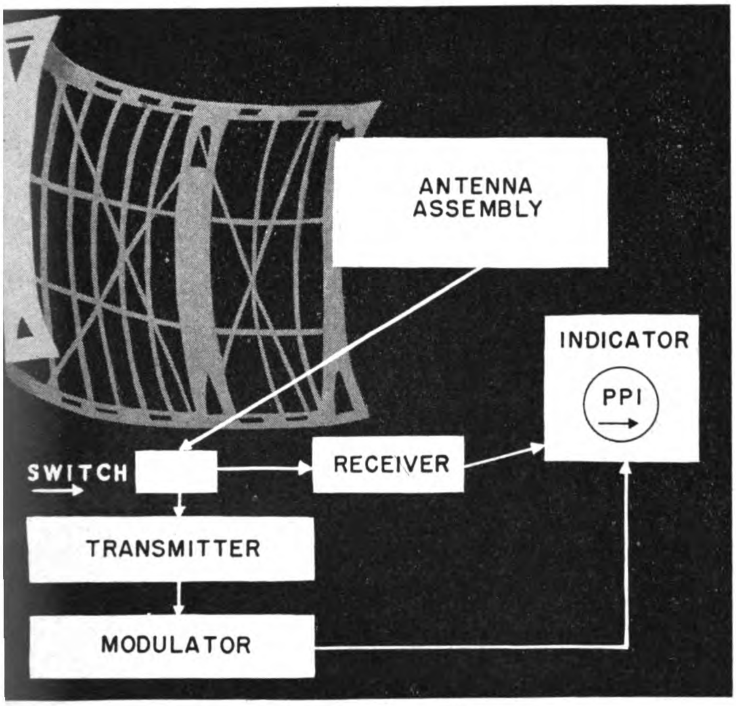
THE MODULATOR

In order that range may be determined accurately, electromagnetic waves are emitted in the form of pulses and each pulse is transmitted for a very short period of time, one-millionth of a second (1 microsecond) or less. After each pulse the transmitter is silent while echoes from that emitted pulse are being received. The procedure is then repeated about one thousand times a second. The modulator, or keyer, is the unit which turns the transmitter on and off and forms these pulses.

THE ANTENNA ASSEMBLY

The antenna assembly is so designed as to beam the energy at the target, normally being accomplished by the use of an antenna and reflector in much the same manner that the headlights of an automobile are directed. The echo is received back through the same antenna and directed to the receiver. While the operator of a radio receiver at home employs a few yards of wire suspended above his roof and finds it adequate, a suitable radar antenna must have the following characteristics: It must be directional, con-

centrating the radio energy into a well-defined beam since this is the method by which the direction of the detected objects is determined. It must be highly efficient with all the energy going into the beam without leading off into "side lobes" in other directions. These side lobes may often prove to be confusing. The radar antenna must also be capable of being rotated or trained in order that the surrounding area can be properly scanned.



BLOCK DIAGRAM OF RADAR

THE RECEIVER

In the receiver, which employs the superheterodyne principle, the radio energy reflected back from the target is converted into a form that may be presented visually on an indicator or scope. Since a very small amount of power is reflected by an object the receiver must amplify it many times. Because the same antenna is used for outgoing and incoming signals a method of disconnecting the receiver from the antenna is needed during intervals when the transmitter is operating to prevent the receiver from being burned out or paralyzed by the emitted burst of radio frequency energy. Within a millionth of a second after the transmitter has completed its pulse, it is then necessary that the receiver be open to receive the relatively weak echo signals. Due to the rapid switching that is necessary, an electronic switch is used.

THE INDICATOR

It is the indicator of a radar that presen information collected in the form best adapted cient use of the equipment. The indicator com used in navigation is the plan-position-indicator monly abbreviated PPI. The sweep starts center of the scope at the time the transmitter originates. While the transmitted pulse is tra out into space and the echo pulse is returnin sweep moves from the center of the scope r to the circumference. When the echo pulse r to the radar a portion of the sweep will be m tarily illuminated on the face of the scope cau "blip" to appear. By synchronizing the rotat this radial sweep to the antenna, the bearing blip on the scope will be in the same direct which the antenna is directed. Because of the tively slow (1 to 20 r. p. m.) rotation of the an the rapid rate of pulsing, the retentivity of the and the persistence of the human eye, a conti picture of the surrounding area is formed on the

RESOLUTION

Due to the type of presentation on a PPI, r tion is divided into two components, resoluti range and resolution in bearing. Resoluti range is the ability to distinguish between two t on the same bearing and closely spaced in Resolution in bearing is the ability to distingui tween two targets at the same range but s different bearings. While the result of good r tion in range and bearing is a clear sharply d PPI picture, given an accurate contour of lan definite pips for small targets, a radar of poor r tion would have a blurred and fuzzy appearanc targets blending together on the scope.

The resolution in range is a function of length, pulse shape, and receiver fidelity. Whi returning echoes are successively amplified by of the intermediate frequency and video circu the receiver, should these circuits modify th turning echoes, poor range resolution will result. optimum band pass of the receiver should quently be from 1.2 to 1.5 times the reciprocal pulse duration in microseconds. As the pulse tion T in microseconds is equivalent to 164T in any targets separated by less than this value w pear as a single target.

The resolution in bearing is directly depende antenna beam width. For any set frequency, width is a function of the antenna dimension creasing as the antenna dimensions increase.

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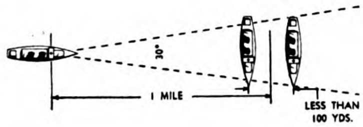

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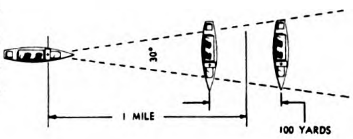

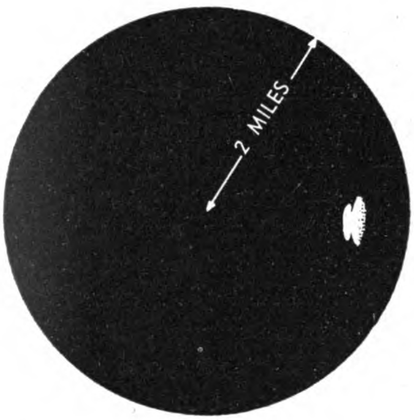

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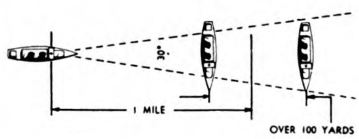


narrow beam width to improved resolution, we increase the over-all gain of the antenna system. However, there is a practical limit of about 1° or 2° where further narrowing of the beam causes targets to be missed due to the small number of pulses that will strike it as the antenna scans the target.

Fanning or spreading of the beam in the vertical plane is desired to eliminate any necessity for stabilization of the antenna, that is to retain energy on the surface as the ship rolls. This in turn considerably reduces the vertical dimension of the antenna. The wide beam in the vertical plane will result in some loss of azimuth resolution ahead as the ship rolls, and abeam as the ship pitches, which again brings out the futility of decreasing the horizontal beam width beyond about 1° or 2°. If the PPI is not stabilized in azimuth (true bearing presentation) there will be an appreciable decrease in bearing resolution as the ship yaws. Another limitation, though relatively unimportant with antenna beam widths above 2°, is the consideration of how closely the PPI scan can be made to follow the antenna.

It is extremely difficult to design a reflector that will direct the radiated energy in a pencil beam. There are generally some side lobes of radiation. These lobes in the horizontal plane should be sufficiently small to be relatively unimportant as compared to the main lobe. In most cases, if these side lobes are from 25 to 35 decibels down, no difficulty will be encountered. No harm results from side lobes in the vertical plane other than wasted energy directed skyward.

In addition, both range and bearing resolution will be limited by the size of the spot of light on the scope caused by the electron beam. Because this spot is not pin point and is the same on all range scales, the range and range scale at which the desired resolution is expected should be stated.

Because of the many factors entering into resolution it is generally expressed as the result to be expected providing the equipment has been designed properly for those factors.

COVERAGE

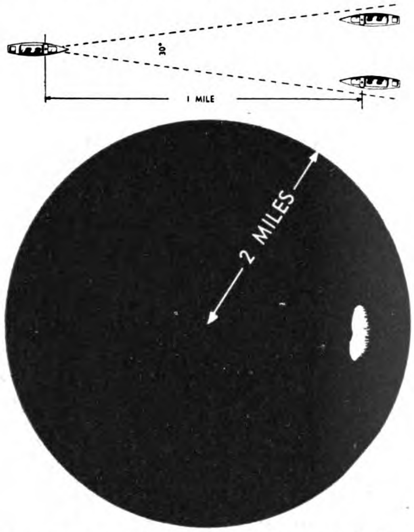
Because of the fundamental nature of electromagnetic waves employed in radar the coverage of a surface radar will be improved by increasing either the antenna height, or the frequency or both. At the present time, however, there is a practical limit to which the frequency may be increased. The attenuation of electromagnetic waves by the atmosphere is a function of frequency and increases at an amazing

rate at frequencies corresponding to wavelengths below 3 cm. Likewise at the shorter wavelengths such conditions as rain, snow, and fog appreciably reduce coverage. Over-all consideration indicated the most desirable wavelength would be somewhere near 3 cm. with good results obtainable with wavelengths as long as 10 cm.

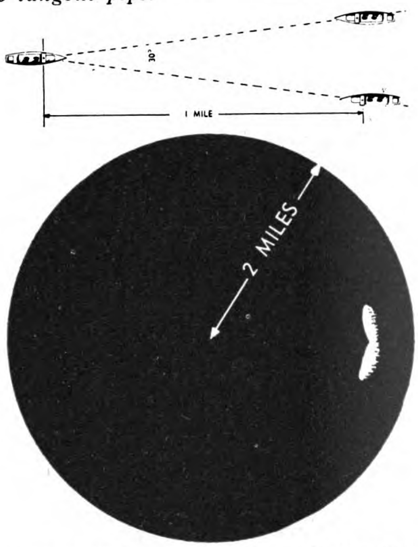
In general, a radar is limited in range coverage to about 15 percent beyond the visible horizon. Hence the range is increased by increasing the height of the antenna and in a like manner a higher object will be observed at a greater range. It is not unusual for a good radar to pick up objects as far away as 100 miles providing they are above the visible horizon. Atmospheric conditions play an important part in range coverage at distances greater than 10 or 15 miles. However, we are primarily interested in vessels located in the area between the minimum range of the equipment and the horizon. The subject of the vertical beamwidth has a bearing on range coverage. The beam should be sufficiently wide in the vertical to illuminate with electromagnetic energy all targets from the minimum range to the maximum in order that all ships will be indicated.

Power output has a considerable bearing on range coverage. It is well known that the reflected energy from the target to the antenna is an inverse fourth power function increasing to a much higher power inverse function at a distance somewhat short of the horizon. Hence small increases in power do not mean much in increased efficiencies. At the same time the realized power is considerably affected by the losses in the transmission line and antenna, the antenna gain, the receiver gain, and other factors. A large amount of power is essential to insure the indication of all above water objects in the vicinity of the radar. The target illumination will also be a function of the pulse rate and speed of antenna rotation as the radar is pulsed at the same time that the antenna rotates. Electromagnetic waves cannot pierce conducting surfaces of any practical thickness. Therefore, masts, stacks, and other obstructions will give shading effects, and objects located in the shade of these obstructions will not be indicated. The desirable speed of antenna rotation is tied in with the cruising speed of the vessel and the retentivity of the PPI tube. One might reason that by increasing the frequency and repetition rate, that more desirable coverage might be obtained with a smaller antenna. This, however, is not true. We cannot pulse faster than the time required for the return of echoes.

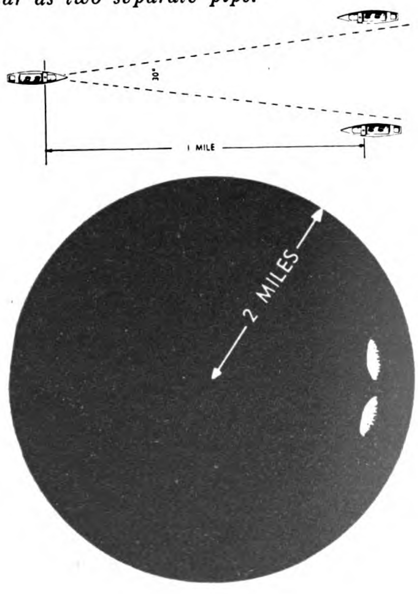
Two targets within the bearing resolution appear as pip.

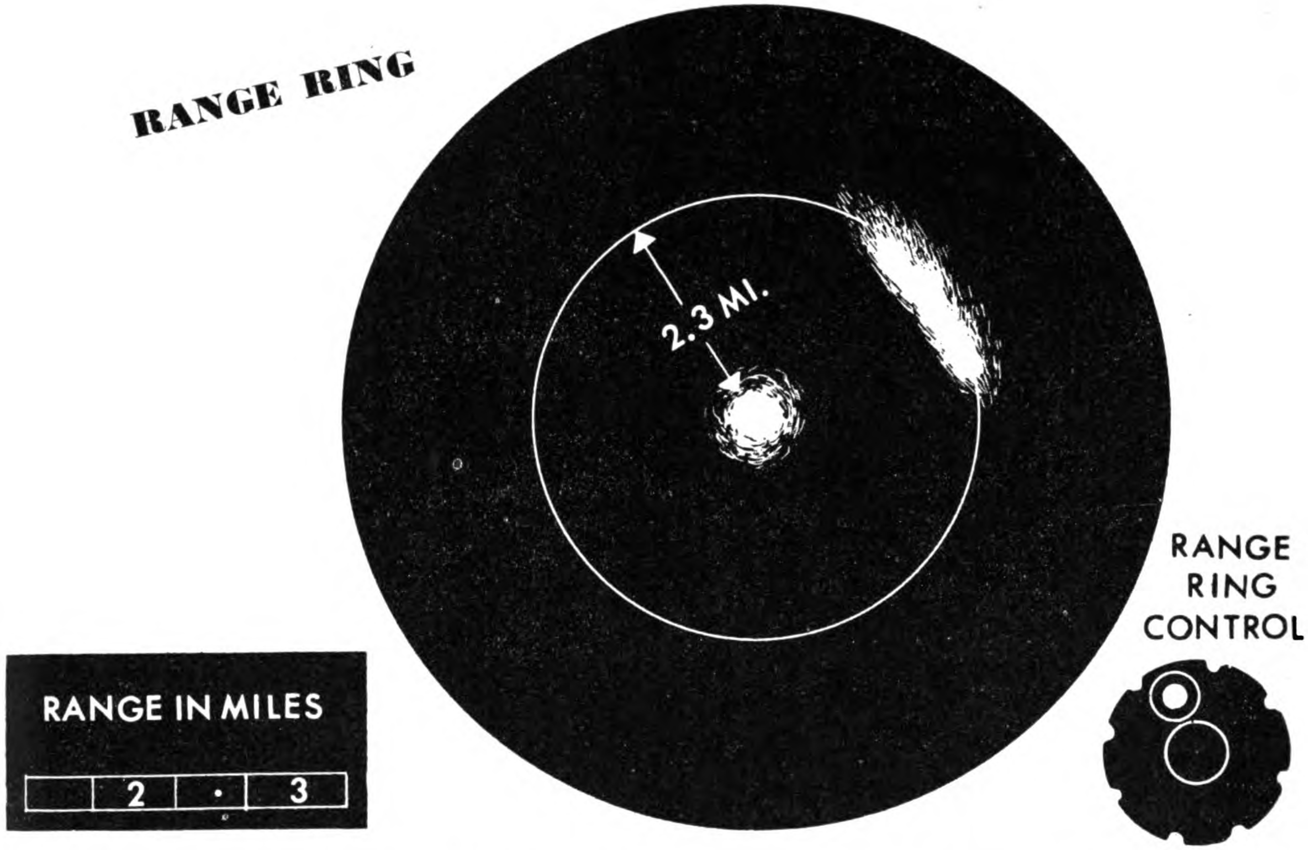


Two targets separated by the bearing resolution a pear as two tangent pips.

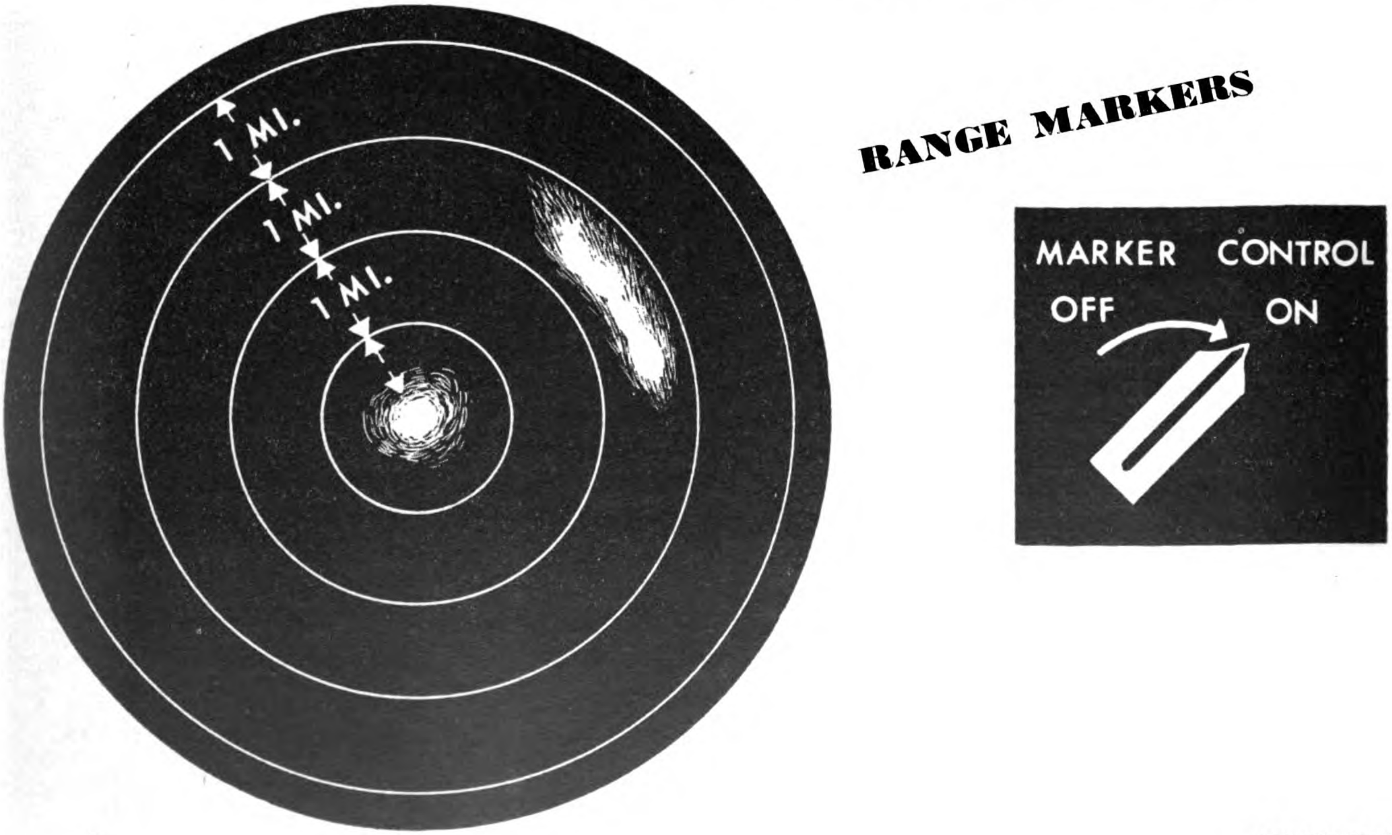


Two targets separated by more than the bearing r angle appear as two separate pips.





Illustrations indicate two methods used to determine range of an object on a PPI scope.



With too low a pulse repetition rate, targets are missed as the surrounding area is scanned; while too slow a scanning rate will not keep a continuous picture on the PPI scope because of illumination fading after the beam has swept by the target. Therefore, with a slow antenna rotation a low pulse repetition rate should be used and conversely with a fast antenna rotation a high pulse repetition rate would be needed. A compromise is consequently necessary. A speed of antenna rotation from 6 to 15 times per minute and a pulse repetition rate greater than 800 pulse per second producing the best results.

INDICATOR DISPLAYS

On the indicator is presented all the information collected by the radar. Although there are many ways of presenting this information the PPI is considered the most advantageous and desirable from a mariner's point of view. While the distance from the center of the scope to the outer edge represents the range from the radar to the radar horizon, this range may be set to suit the individual needs of the user depending upon the areas in which he will operate and possibly to the scale of the charts used. Generally three different range scales are available to be selected at will. The choice of the lowest range scale, although dependent on magnification desired for operating in confined areas, has a lower limit dependent largely on the resolution. At the present time, nothing is gained by using a scale smaller than 2 miles, and on the poorer resolution equipments even this low a scale produces such a fuzzy and indistinct picture that it has no value. The second scale, being the one normally used, is generally set to the range of the optical horizon (60 to 10 miles). The longest sweep is invaluable as an aid to navigation particularly in areas where high mountains line the coasts and under conditions where radar ranges exceed those normally expected. Because of the design problems in obtaining a linear sweep this highest scale is limited by the shortest scale to less than about 50 miles.

The size of the PPI scope will to some extent govern the range scales that should be used. While a large scope gives an enlarged picture, other factors such as illumination and definition dictate the use of a scope about 7 inches in diameter as the optimum. As the radar provides an excellent means of precisely measuring range and bearing it is believed that range and bearing knobs should be provided with precise means of determining these factors, particularly on the better type radars. Even less expensive r should retain the means for precise bearing mea ment as this factor is predominent in determ whether or not two ships are on a collision c The methods of determining range generally use by means of a movable range ring geared to a or counter and by using fixed range markers (ci to which the range of an object may be referred is the unanimous opinion that no more than fo five range circles should be used on a 7-inch scope and that means should be provided to elim the range circles when not in use.

In measuring bearing, there are two methods able. The first is by considering the top o scope as being in line with the bow of the ship measuring the bearing relative to the bow o ship. This method has distinct disadvantage the ship turns in one direction, the pips on the move in the opposite direction causing a trail left on the scope due to its persistence. In add the PPI must be closely observed during the tu later confusion will result in the new placeme objects about the scope. In the second meth bearing indication which has won favor with Navy, the PPI is stabilized in azimuth so that th of the PPI is always north. A marker is then fl when the antenna is pointed toward the bow to cate true heading. This method enables both and relative bearings to be determined readily, serves the resolution of the equipment and doe have the undesirable feature of the relative be presentation. The picture on the scope is then lar to a chart with the addition of the movabl jects. For this latter method, however, the ship be gyrocompass-equipped.

In cases where expense would not justify a elaborate radar, it is believed that a type of utilizing "A" scope presentation, that is, range v echo amplitude indications, would be valuable anticollision device and for rough navigation. an installation would require the services of a cialized observer and plotter in order that anticol features may be realized. If an "A" scope is the speed of rotation of the antenna should not e four or five r. p. m. as it is very easy to miss ta with this type of presentation. Means must be vided to stop the antenna and carefully search a tion where a target is noticed. Experience ind that the antenna of such a radar must be m driven to be of any value.

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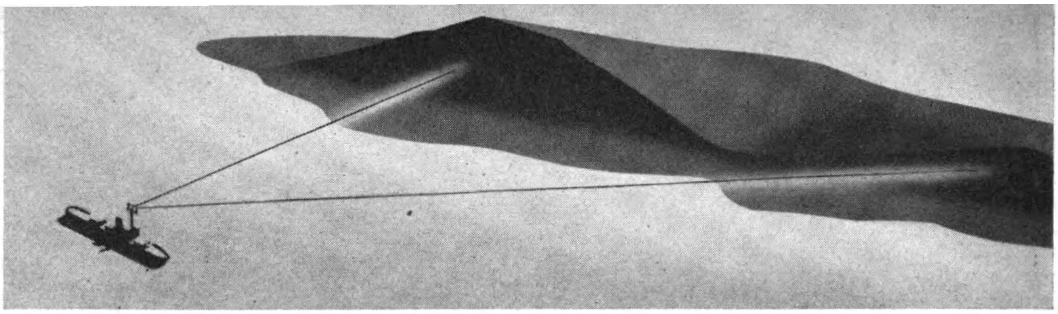

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ABILITY AND SIMPLICITY OF
ATION

we are dealing principally with the use of radars rchant vessels, it is apparent that such equip- must be dependable and foolproof. Experience tes that most radar failures are caused by knob- rs and button-pushers. It is, therefore, essential ll adjustments not absolutely necessary for rou- peration be screw-driven adjustments that are l inside the cabinet. This, then, will reduce the er of controls on the face of the equipment to a number. Rotating machinery associated with quipment is a constant potential source of e. In the case of ships equipped with alter- current it would be highly desirable to have ower taken directly from the ship's lines pro- the regulation is adequate. In this case high- e relays should be provided to protect the nent in case of voltage surges. Ships equipped lirect current, of course, will require a converter. onnecting cables, connections, interlocks, and ire a constant potential source of trouble. Con- 's should be eliminated altogether and the de- ich that a minimum of interlocks are required. ses should be mounted where they are readily ible and blown fuse indicator light provided. se of the limited radar training that any per- aboard ship would have, servicing, except the ing of fuzes and possibly the changing of the r common tubes, should not be attempted ex- by authorized service personnel or company ntatives.

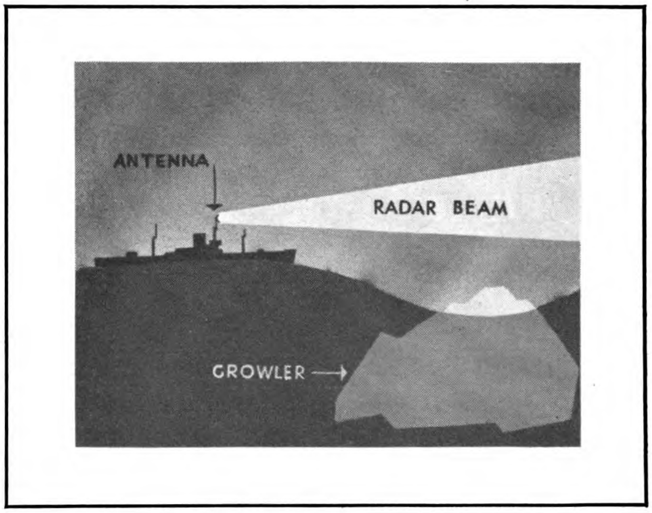
ould be highly desirable to have one meter pro- with a selector switch to indicate primary power , rectified d. c. voltages, receiver crystal cur- nd magnetron current or similar devices to in- that the radar is performing properly. The value of these readings should be entered on a time of installation and this card posted under ar the equipment.

e sort of arrangement, either built in the equip- or permanently mounted near the equipment be provided to indicate relative over-all per- ce of the radar.

The equipment performance must be constant over long periods of time as the tuning controls will not be accessible to operators. To realize the best per- formance of the system, preventative maintenance would provide a periodic check on the equipment.

INSTALLATION

The installation of a radar aboard a merchant vessel is governed by the available space and the op- erational performance desired of the radar. Consid- erable discussion has arisen concerning the question of whether 360° azimuth coverage is practicable. It is firmly believed that this feature is essential in the interests of safety at sea. While an installation on the top deck of the pilot house of a vessel is ad- vantageous from the point of view of simplicity of design and installation, this location limits the heights of the antenna and hence the range, as well as cover- age astern. The total area covered by the radar varies as the square of the distance to the horizon and directly as the angle of clearance to the horizon. It would seem to be poor economy to pay a relatively large amount for a radar and then limit its quality by a faulty or poor installation.

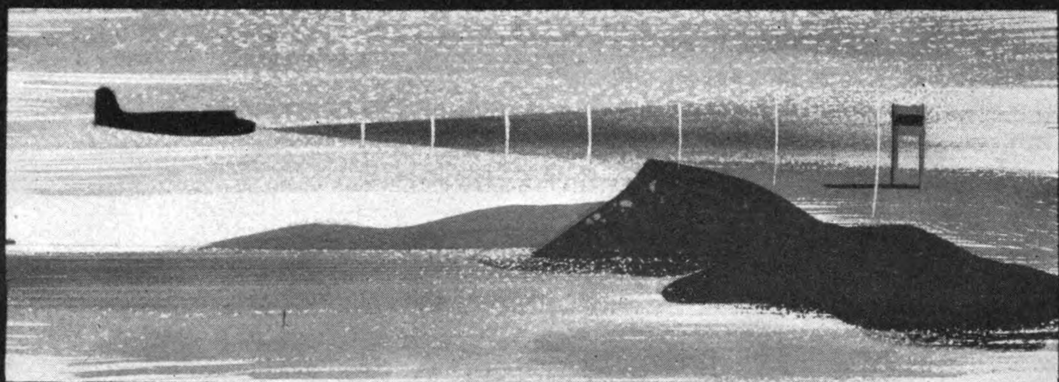


Growlers or small icebergs can be missed by radar beam as ship pitches (or rolls). Echo returns from tops of waves in a seaway cause sea return and interference which may obscure target.

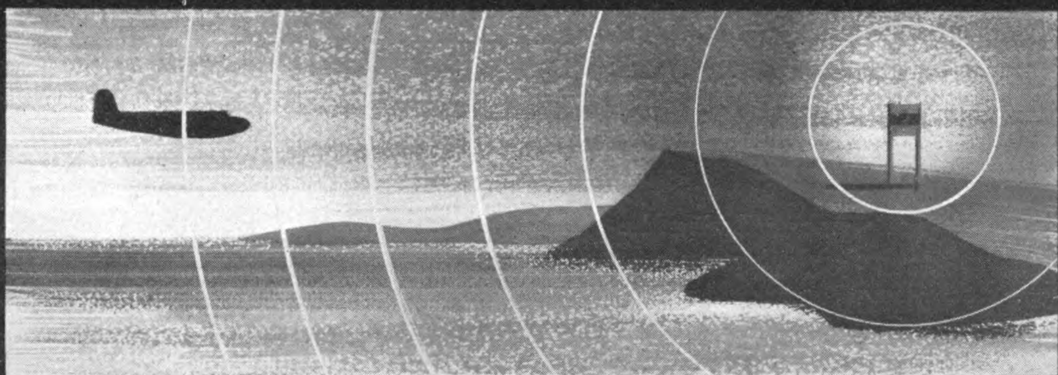
While the majority of naval installations have located the antenna on the masts for greater range, such an installation on merchant vessels would present difficulties due to the use of the masts to support rigging for cargo handling. At the same time it would be necessary to either run an excessive length of transmission line to the antenna or mount the transmitter and receiver units nearer the antenna. One satisfactory solution has been to place the r. f. components in a waterproof cabinet and mount the cabinet on a bracket secured to the mast. In view of the difficulties in mounting the antenna on the mast and the need for 360° coverage the ideal position for an antenna would be on a short platform or tower mounted above the pilot house. On most ships this tower would only need be 15 to 20 feet high to be above the stack, and considering the overall radar investment this tower would be but a small item. The navigational and anticollision qualities of the radar indicate that the indicator be in the pilot house. The equipment may or may not be a single unit. The most flexible procedure has been to build the equipment in three or four packages, that is the antenna and associated equipment in one packag r. f. components and receiver in another an indicator in another. On d. c. ships a conver motor generator would be required which co located in the engineroom where it may r proper attention, the indicator could be moun the pilot house, and the r. f. component co mounted as convenient for a short transmissio run to the antenna.

ADVANTAGES AND LIMITATIONS

In discussing the possible application of ra marine use, it is not intended to imply that methods of navigating and piloting will become lete, but rather that radar will supplement Hand-leads, fathometers, radio direction finder tants, all will continue to be used. Radar's advantage is that it will function, in fog or weather, where orthodox methods and equipme not. Some mariners will be reluctant to depe radar until they prove its value through person perience. Too great a dependence on radar, exclusion of ordinary precautions, may result



Plane transmits series of pulses during search for radar beacon. Pulses trigger beacon, which sends out assigned series of coded pulsations replying to each pulse from plane.



ts. Radar's value as a maritime safety aid will ıd largely on its intelligent application and use. ıown operational advantages may be summed up lows:

(*a*) It is the best anti-collision device yet per-'ected.

(*b*) It is an invaluable aid to safe piloting, ɔr in making landfalls during periods of low ʳisibility.

(*c*) It indicates continuous, instantaneous ·anges and bearings of objects.

(*d*) It gives a chartlike picture of the sur-·ounding area, the projection being in the nature ɔf a polar chart with PPI presentation.

(*e*) Through scope observation, it provides ɿuick note of the movement of objects.

. the other hand, radar does have its limitations ıny proper consideration of its value must weigh against its proved advantages:

(*a*) Objects cannot be readily identified with-ɔut the aid of other electronic devices, electrically :oordinated. All objects of comparative size ɔresent the same pip. However, identification :an sometimes be made by implication, such as novement, relation to other objects, shape (used n landfalls), and, at times, the initial range of letection.

(*b*) Radar chart projection on the scope re-ɿuires interpretation due to line-of-sight char-ıcteristics which give shadow effects. In other vords, larger intervening objects may blank out ɔbjects behind them.

(*c*) Radar can only be used reliably for lightly more than the line-of-sight distance.

(*d*) Weather and sea return will affect the ɔicture.

(*e*) Objects, such as buoys and small boats, ıre sometimes undetected when they bob up and lown in a seaway. Outgoing signals will miss triking such objects when in the trough of a vave, therefore there is no reflected wave for ɔrojection on the scope.

(*f*) Non-conductors, such as wooden vessels, nay give a poor echo.

FUTURE

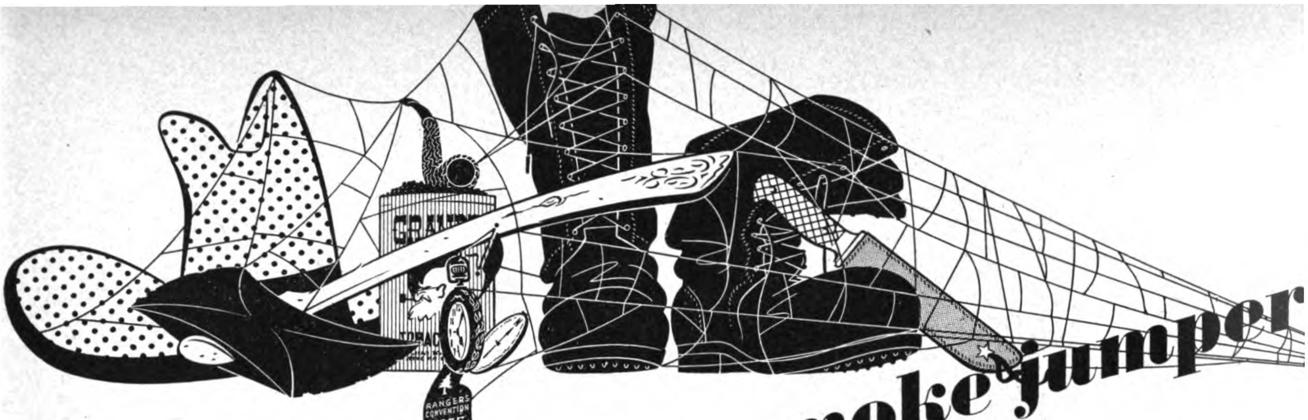
the light of radar's achievements during the revelations of which are just beginning to throw on one of the most amazing electronic develop-s of all time, to predict where the line will finally be drawn would be an odds-on gamble. Signals to the moon and back again—nearly 500,000 miles all told—in less than 2½ seconds! More than the vision of a Jules Verne is required to envisage the implications which lie in that single accomplished fact.

Military radar proved invaluable during the war in searching out surface vessels, detecting enemy aircraft and controlling gunfire. Shoran radar made it possible to bomb enemy troops only a few hundred feet ahead of our own advancing forces. The use of blind Shoran bombing over the battlefields of Europe showed it capable of equaling visual bombing in accuracy under normal conditions, and surpassing it when visual bombing suffered from target identification difficulties. The demoralizing effect of a bombing by cloud-hidden planes was tremendous.

A micro-wave radar set was instrumental in combating German rocket bombs. It also provided early warning of approaching enemy aircraft, detected the movement of enemy transportation along roads, tracked meteorological balloons, traced the flight of enemy shells and mortars.

By the same token, radar's peacetime potentials, intelligently applied, are practically unlimited. Racon, for instance, is one phase of development which offers tremendous possibilities for the more efficient use of navigational aids, both marine and air. The essential difference between radar and racon is that unlike radar, which depends upon a reflection of its own energy to determine the existence and position of an object, racon is made up of a receiver—transmitter combination which sends out a coded signal when actuated or triggered by a radar signal of the proper type, received from an airplane. The airplane determines its range and bearing from the racon station, and the identity and position of the racon, by the presentation of the racon signal upon the radar scope. The advantage of this type of radar aid to navigation is that a single beacon in an area is enough to enable the airplane to navigate in any condition of weather and at a much greater reliable range than with radar alone provided, of course, the plane carries the required radar interrogating equipment.

This is but one promise for the future which the science of radar offers a peacetime world. It will help reduce to a minimum the loss of life and property at sea. It will help to avert such aviation accidents as that caused by a lost plane crashing into the Empire State Building. How much more it will do to advance the science of safe air and sea navigation is limited only by the imagination of the men who are working to expand its field of usefulness.



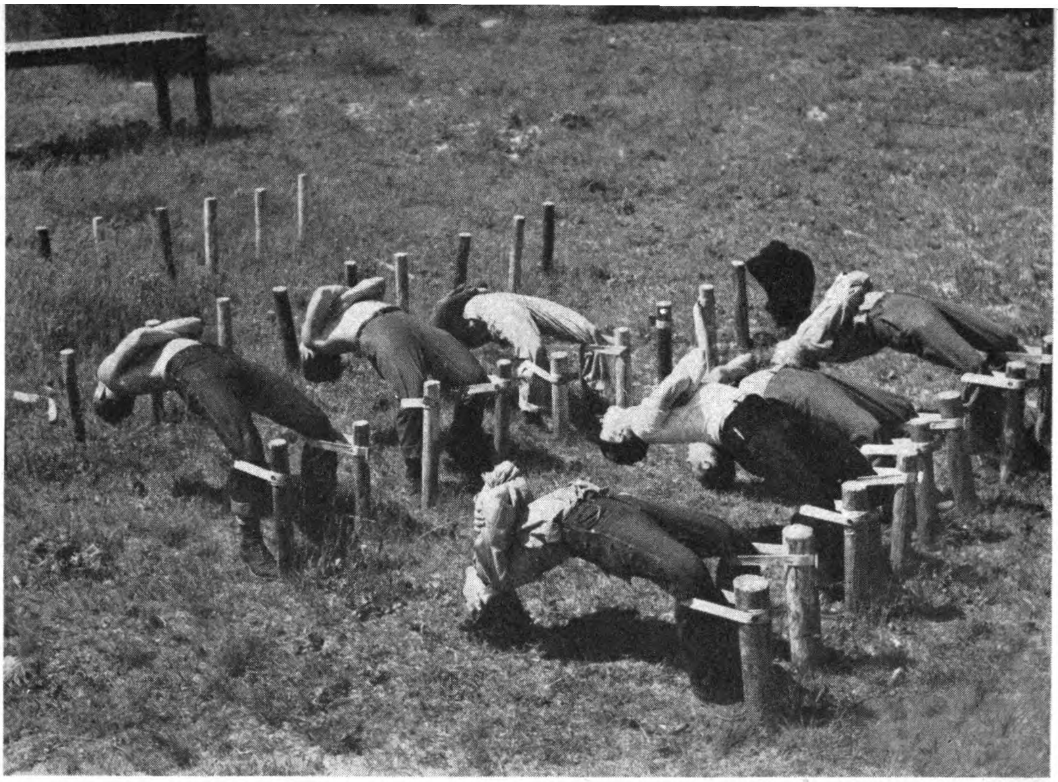
smoke jumper

The wilderness has not yet completely vanished from the face of America. In Western Montana, northern Idaho, and northern Washington lie the country's last undeveloped primitive areas—vast rugged, forested regions not yet invaded by roads, ranchers or other elements of civilization. From the scrub pine of the Alpine country to the giant redwoods of the Pacific slope, from the lush reproduction of back-country valleys to the sparse growth near the timberline—here serve the smoke jumpers of the United States Forest Service.

The original smoke jumpers were woodsmen trained as parachuters; they were mountain boys—lads from the brush country—who all their lives had had the great north woods for a back yard. Born and reared among the mountains they had found the forest service a natural profession for their native training. Most of them had never ridden in an airplane; none of them had made a parachute jump.

At first 180-pound dummies attached to condemned Army parachutes were dropped over various types of cover and topography. Observation was maintained from the air and on the ground. Then began the jumping of men. The first were professional parachute jumpers but soon they were followed by two local men of "smoke-chaser" experience who had never seen a parachute before. As far as is known, these were the first premeditated jumps over rough and timbered terrain.

Side view of a fully equipped smoke jumper. He is wearing a 26" back pack parachute and a 24" chest pack parachute, both connected to harness specially designed to permit of detachment of risers from shroud lines; football helmet to which has been attached specially made steel wire mask for face protection; and padded suit made of heavy duck—pocket in right pants leg contains 60' let-down rope. Whole suit zips off. Collar is stiffened to protect back of head and chin. Jumper wears specially designed abdominal and back brace under suit.



taken in the Forest Service g school area at National Forest Missoula, Mon-

ce the feasibility of the project was established, ng headquarters were set up at the regional t Service office in Missoula, Mont. Consider- preparatory work was necessary because existing ment was not suited to the work. As the train- rogressed, there was constant alteration and im- ment in equipment and also in flying, jumping, anding techniques.

1942 the military services took an active interest e project. Search and rescue units were more nore frequently faced with the necessity of aid- ane crews forced down over uninhabited moun- is country. To the Forest Service school in ula came representatives of the Army's 2d Air , Coast Guardsmen engaged in rescue work in a, and members of the Canadian R. A. F. this cooperative training has grown one of the efficient "assist plays" in our search and rescue e. Smoke jumpers of the Forest Service have been part of rescue crews and have aided in ng, reaching, and evacuating the personnel of ed aircraft. Fighting forest fires has always been till is the chief occupation of the smoke jumper, nany a pilot is flying today who owes his life to noke jumpers of the Forest Service who located ane, parachuted to his aid and led him or car- him out of a trackless region.

e training back of the Forest Reserve smoke ers is some of the most intensive and rigorous conditioning anyone can experience. The first men chosen for this work were woodsmen and fire fighters of long experience; men who could pass the most rigid physical examinations. The years since 1939 have contributed to the training routine. Each phase of progress has been developed to make jumping safer and more efficient. From season to season new training techniques have been added—old ones discarded.

First on the morning training program is a brisk jog around the camp; calisthenics follow with exercises designed to strengthen the legs, arms, neck, and back. "Obstacle course next," says the squad leader. Descending into a pit, the squad finds a motley collection of ropes, ramps, nets, stakes, and tubes. One by one the men run up the first steeply inclined ramp, grasp the edge, drop 7 feet to the ground and roll. Ahead hangs a rope to climb from which they step to a wooden platform and turn a flip into a rope net. Then they run along two angle strengtheners, three planks arranged in concave and convex shapes. The horizontal ladder follows. Dropping from this, the embryo smoke jumper runs uphill toward a series of alternate shallow holes. Like a football halfback he crisscrosses his feet as he stumbles past this obstacle. Then comes the tight squeeze, a pair of corrugated tubes through one of which he must wriggle on elbows and knees. The final hazard on the obstacle course is another lower ramp designed for more intensive "hit and roll" practice.

On his first morning of ground training the jumper is instructed on the construction and handling of the parachute. In a mock-up, he is taught the art of suiting up in a plane, signals used by the spotter, use of the static line, and the proper technique for leaving the plane.

Reserved for last is the jump tower. Fully-equipped men jump from a 25 foot tower and are stopped in their fall 5 feet above ground by a large rope attached to their harness and snubbed to an overhead boom. This part of the training has been devised to simulate opening shock of the parachute, to overcome a natural adversity on the part of the trainees to jumping from high objects, and to give them practice in leaving the plane door and sustaining an upright position prior to opening of the parachute.

During the final stages of training, the trainee makes seven actual jumps from a plane. During this series of jumps he learns to guide his chute, stop oscillation, land in timber and slip a chute. Contrary to popular opinion, jumpers find that trees are like springs and soon prefer them to hard ground. Close stands of healthy lodgepole pine are referred to as "feather bed landings." For a tree landing, each jumper carries with him two ropes, the short one to release himself from his parachute risers and the longer one on which to lower himself to the ground. This latter technique he has learned by practice on a suspended cable during his prejump training.

The present equipment of parachute, harness, and protective suit is the result of experimentation and development. The standard harness provided with parachutes proved to be a handicap in tree landings. When a man was hanging suspended from the crown of a tree, the pressure on the leg and chest straps was so great that he found it impossible to unsnap the connections and free himself. Where heretofore the jumper's harness had been an integral part of the riser straps, shroud lines and canopy, it was made an individual unit, detachable from D rings on the riser straps. Upon landing in a tree, the jumper passes his lowering rope through these D rings above his head, detaches the harness straps and lowers himself in suit and harness.

The original protective suit designed for the smoke jumper, though an excellent beginning in an uncharted field, has since undergone complete revision. The present suit is two-piece and made of light duck. The pants reach high above the natural wa fitting over the lower end of the jacket and ar ported over the shoulders by heavy elastic susp bands. They zip open from waistband to fee large pocket is provided on the leg, between the and knee, to hold the lowering rope. The j which is closely belted above the hips, has a z opening from bottom to collar. The collar is and made of slightly padded duck; and while it erect, it will bend easily forward or backwa visibility. The vulnerable spots on both pieces suit are padded with layers of wool felt in orde the utmost freedom is permitted.

A well made football helmet is essential. H over the face of this is a convex mask of a steel wire to protect the face from tree branche

In addition to ground training, actual p jumping and the program of physical conditi trainees at the Forest Service parachute school given instruction in parachute rigging and fir

Scenes taken in the U. S. Forest Service training scho at Lola National Forest near Missoula, Montana.

· jumpers being trained on "let-down" rig to become ır with method of disengaging from chutes caught in at a training camp in Lola National Forest near ıla, Montana.

(*e*) Packing and maintenance of eight types of parachutes used in smoke jumper work.

(*f*) Maintenance and construction of harnecesses, trays, containers, covers and other items of equipment used in parachute work.

The first-aid training was conducted by three of the trainees who were qualified first aid instructors. Under their instruction, the majority of the men obtained standard or advanced course first-aid cards.

The rescue angle of the Forest Service parachute project came as a result of the need for search and rescue during the peak of the war years when pilots were forced to ditch over mountainous country.

In March 1943, the Forest Service in Missoula was contacted by the Coast Guard from Ketchikan, Alaska, for the purpose of establishing and training a search and rescue unit in parachute jumping. As a result of information and facts provided at that time, the Coast Guard was convinced that the facilities available through the Forest Service were adequate for the training proposed.

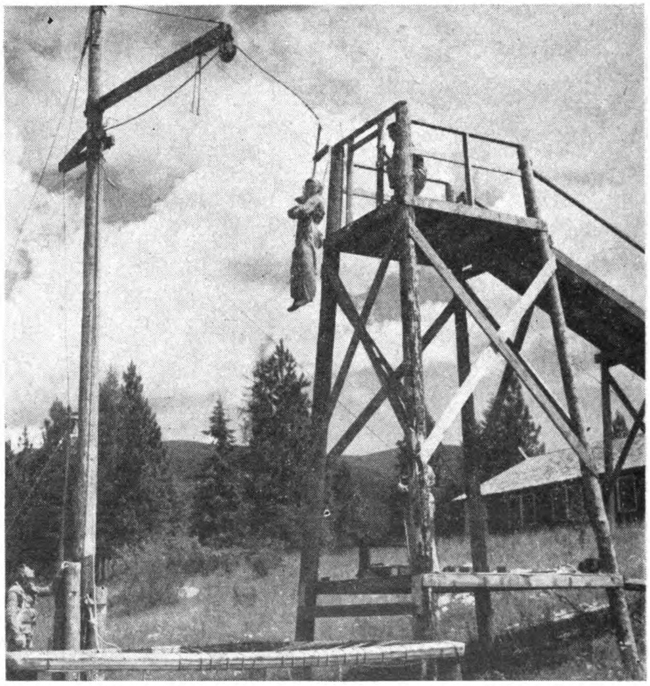
ɛ scarcity of experienced riggers necessary for ıg and repairing parachutes made it advisable e Forest Service to train their own riggers. Six an Public Service assignees and five Forest Servgulars were selected. All of the regular Forest :e men taking the rigger course qualified with Civil Aeronautics Administration and received licenses as parachute technicians with rigger ;s. Because of a technicality arising from their as civilians, the CPS riggers were unable to y with the CAA as licensed riggers. However, performed satisfactorily under the supervision of egularly licensed Forest Service riggers. The course consisted of the following:

(*a*) Instructing and familiarizing the trainees vith the various parts of all types of parachutes nd their function.

(*b*) Familiarizing the trainees with all mateials involved in parachute work.

(*c*) Instruction in operation and maintenance f five types of sewing machines involved in arachute work.

(*d*) Instruction and practice in repairs and listinction between major and minor repair as lefined by the CAA.

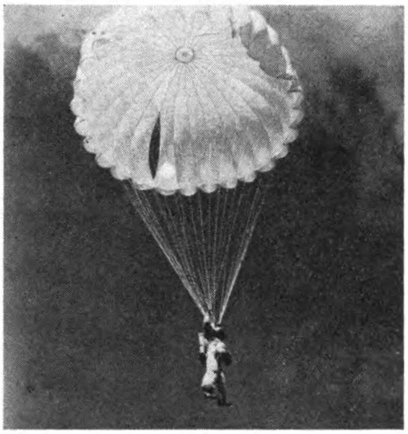


Scenes taken in the U. S. Forest Service training school area at Lola National Forest near Missoula, Montana.

On July 28, 1943, 10 members of the Coast Guard arrived in Missoula and were established at the Seeley Lake training camp. This crew was given the same training as had been given the CPS and Forest Serv-

ice men earlier in the spring except that a greater amount of time was spent in the ground training phases and conditioning. The group was given an average of 9 jumps each during the training and all obtained a high degree of efficiency in jumping.

The expense of training the Coast Guardsmen, their subsistence excepted, was borne by the Forest Service in exchange for the availability of these men for firefighting purposes during their training.



Scenes taken in the U. S. Forest Service training school area at Lola National Forest near Missoula, Montana.

In September, Captain Frank Wiley of the Flying Safety Division of the Flight Control Command, Army Air Forces, contacted the Forest Service in Missoula for the purpose of obtaining cooperation in establishing a series of search and rescue units throughout the area administered by the Second Air Force, and to obtain assistance in the training of medical officers to be assigned to the various units in that area. Captain Wiley's recommendations were accepted by the Army Air Forces and training was begun by 13 Army officers at the Seeley Lake Training base on November 3. The training and resultant search and rescue activities of this group are discussed in the article *The Paradoctor* in this issue of the *Air Sea Rescue Bulletin.*

During the training of the medical officers, arrangements were made by the officer in charge of the Search and Rescue section, Second Air Force, for the Forest Service to aid the search rescue section in crash rescue work. In anticipation of this work, on the part of both Forest Service jumpers and trained Army medical officer jumpers, advantage was taken of the training and experience of the training officer from the Second Arctic Rescue Squadron at Buckley Field. An intensive course in Arctic and mountain travel adapted to rescue party work was presented by this training officer, and the theories presented were practiced by Forest Service and medical me during training hikes and conditioning trip bad weather prevented jumper training. arrangements made by the Search and Rescue Second Air Force, three men were maintainec Forest Service parachute loft at Missoula at expense. These three men, as well as the thr regularly employed by the Forest Service for work were available to cooperate with the A search and rescue missions. During the months they participated in a training missio into the back country southwest of Missoula mission was successfully completed for the pu determining the adaptability of the equipment eliminate certain difficulties anticipated in con with winter parachute jumping in timbered covered, mountainous country.

Two other contributions were made dur summer to the parachute jumper training armed services. In conjunction with the trai the Coast Guardmen during August and Sep two officers of one of the Canadian Airline T Schools were given training in spotting and pa jumping. These men with the sanction of th ernment and of the U. S. Army Air Force trained to form rescue units to operate in the Western Canada. The second contribution armed services was during the training of the Air Force and the Arctic Rescue Squadron of November when four Army parachute rigge provided with 3 weeks intensive instruction an tice in the Forest Service method of repair an tenance of Forest Service types of equipment of the four riggers were given a training jum request of the officer in charge as a practical the rigger training course.

The expansion of the parachute project ha the experimental status. The manpower shor perienced by the Forest Service during the w has held back advancement, but the success back of the small group of smoke jumpers has the workability of the plan. Since the establ of search and rescue training centers by the services, the Forest Services' job of training personnel is finished, but their job assisting i and rescue continues.

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l down" effect of the upper pocket provides ready access to all items. ps at each corner of the cover flap for securing the flap at the sides. ntainer.

new jungle kit

original jungle kit (S2–1057) developed dur- ıg the early part of the war and devised prin- ɔr aircraft has been recommended for deletion Medical Department Supply catalogue. This nall cardboard container with miscellaneous ıupplies) cannot be conveniently carried by an al, and the contents are not entirely applica- se in jungle areas.

recommendation of the Naval Medical Ma- ıard, the Medical Field Research Laboratory, ejeune, has developed a new jungle kit. The l container is essentially two pockets, one of ɔlds up over the other for compactness. The the lower pocket is continuous with a cover ch folds down over the upper pocket to hold ce.

uestion of the amount and variety of first aid which should be furnished an individual is much argument. Obviously, the amount of must be limited to essential items which may ɛrly used by a person who has only a rudi-

mentary knowledge of first aid. However, supplies must be sufficient in amount and variety to give the individual a feeling of security in that he may take care of himself or his buddies when isolated from regular medical attention and supervision.

The supplies for the proposed kit were selected by three Medical Officers all of whom have had field and combat experience. The items they selected were considered from the standpoint of treatment and the maintenance of health in jungle areas. Selected for treatment were bandages for large and small wounds; tincture of iodine for small cuts and bruises; sulfadiazine tablets for oral administration for large wounds; morphine for pain; aspirin for headaches; and opium tablets for diarrhea. For the maintenance of health atabrine, water purification tablets, insect repellent, and an anti-chap lipstick were selected. Upon the advice of the Medical Officers a booklet of instructions for use of the supplies with a review of the more important first aid treatments has been included in the kit.

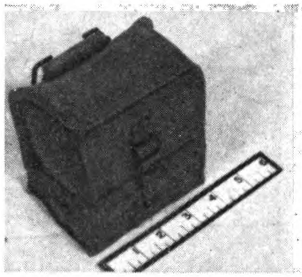
It will be noted that the Army's water purification tablets (100 halazone tablets in a small bottle) were recommended rather than the combination of halazone and sodium sulfite known as the CDC Packet which is carried in stock by the Medical Department of the Navy. The reason for this is that there are sufficient halazone tablets in the one small bottle to treat 100 pints of ordinary water whereas the contents of one CDC Packet will treat only 10 pints. The difference in displacement of the bottle and packet is negligible—the bottle being slightly larger.

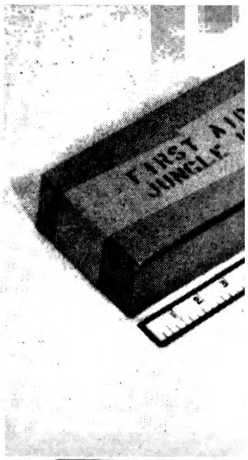
Also, the Army's ½ oz. hard rubber or plastic vials were recommended as containers for the tablets and morphine syrettes rather than the glass containers (stock No. 13–065) listed in the Navy Medical Supply Catalog. The plastic vials are more durable and have a slightly larger mouth thus allowing packaging of sulfadiazine tablets which is impossible in the glass vials.

To package the first aid supplies a simple, compact, canvas duck container has been designed. The container and contents will weigh approximately 1½ pounds. The kit may be worn suspended from a cartridge belt in the same manner as a canteen, or it may be worn attached to a trouser belt. Neither method hinders movement nor causes discomfort.

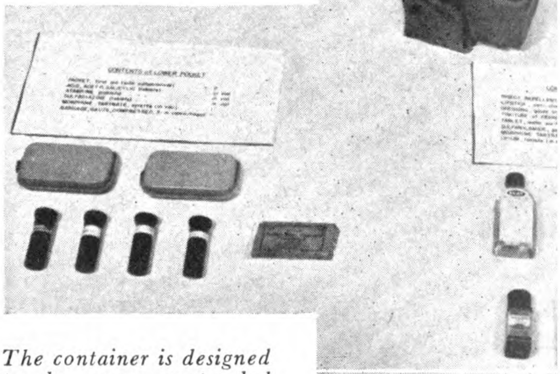
The two-pocket design of the container, and loops in the lower pocket for insertion of the vials, permits segregation of the contents. The roll-down effect of the upper pocket provides ready access to all items.

aid kit, Stock No. S2–1057. On the left is the new proposed replacement.

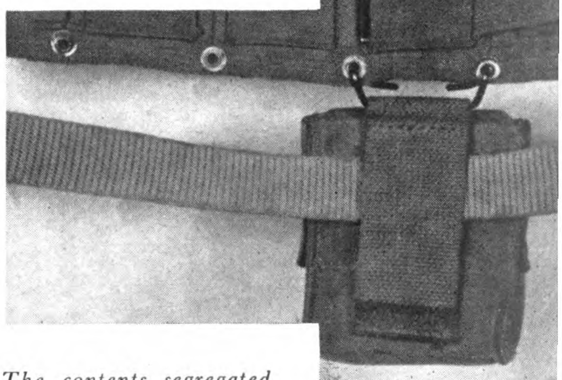




Medicinal items considered necessary for emergency use in jungle areas comprise the contents of the proposed kit.



The container is designed to be worn suspended from a cartridge belt or attached onto a trouser belt.



The contents segregated in the two pockets are readily available as is shown here.

scue equipment facilities tested

hough the necessity for flying long combat missions is a thing of the past, frequent trans- flights to Europe and areas in the Pacific have l in a continuance of air sea rescue facilities. ly, effective search and rescue flights resulted rescue of passengers and crew of a San Fran- ound army transport plane forced down in waters.

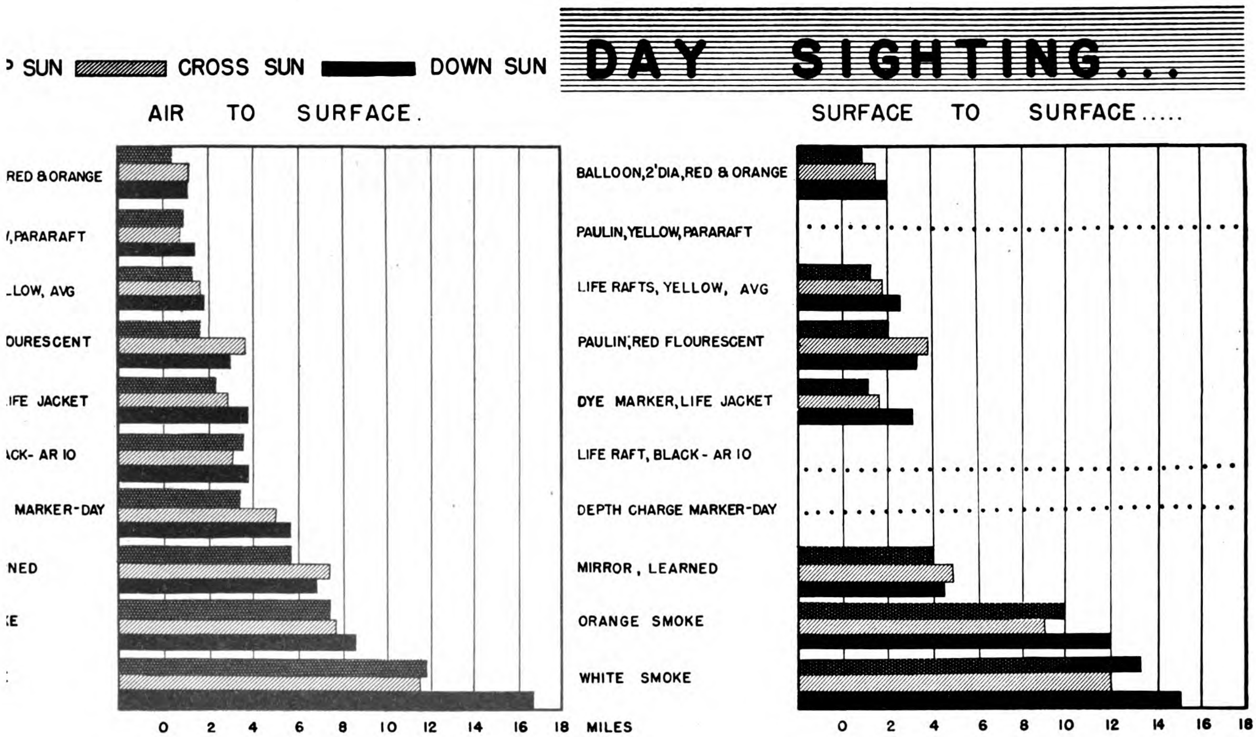
ıir Sea Rescue Agency advisory memorandum, / published, points out that while ditching on ter flights in peacetime occurs rarely, the lives v members and passengers floating in small ill depend to a large extent on the effective- the search methods.

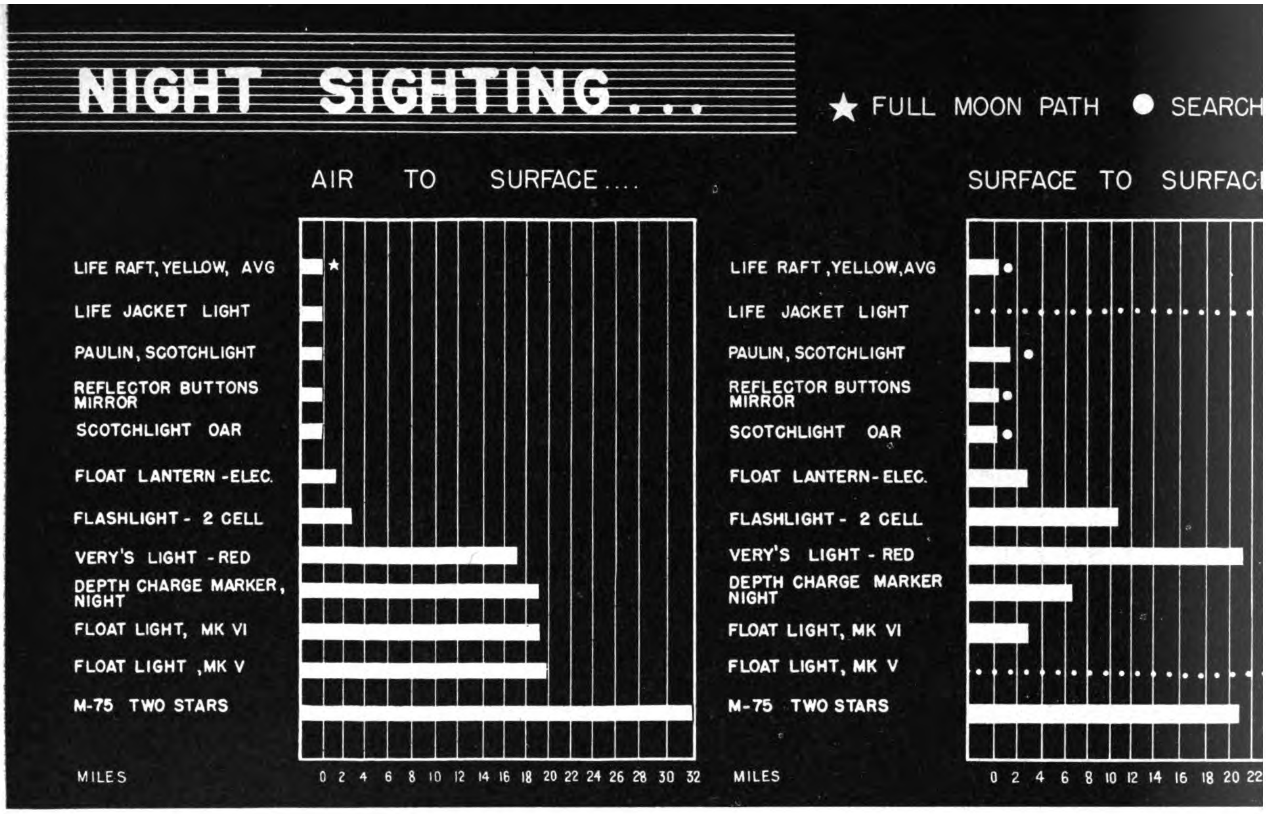
ıe first attempt to isolate and analyze the many es affecting the visibility of life rafts, emer- signaling equipment and all search methods, .vy recently completed a 60-day test at San Calif., in which 2,000 measured observations ıade from the air and approximately 140 runs ıade on the test target from surface vessels. accompanying charts indicate the average distance of sighting for various types of emergency equipment in the Navy tests. It will be noted by reference to the charts that smoke signals are visible at the greatest range in daylight; they are particularly important on cloudy days when the signaling mirror cannot be used.

The Navy tests revealed that the best search altitudes are to be found at 500 feet in daytime and 1,000 feet during night flights. Effective search is best in down-sun areas in the daytime and practically hopeless in the up-sun areas when searching for life rafts not equipped with proper signaling equipment.

The Navy believes that too much emphasis cannot be placed on the importance of color contrasts in sighting small objects on the sea, therefore they must be sought in directions where they receive the best illumination to obtain color brightness contrast. The direction in which white caps are seen the farthest is generally the best direction for search.

In daylight, search is most effective during the period from mid-morning to mid-afternoon. The best search track in clear daylight is the "creeping





line" forward down-sun; for overcast and night conditions, the best track, according to the Navy tests, is the "expanding square."

Night signals are more effective than day signals although in a night search from the air for rafts not equipped with proper signaling devices, discovery is purely a matter of chance. The Navy experimenters reported that rafts were not sighted in repeated search flights covering a full moon's path from a 500-foot altitude.

The experiments carried on at San Juan revealed that day and night search for a man bobbing in the Pacific wearing a Mae West is almost hopeless if the downed airman is not equipped with signaling devices. In making this fact known, the Navy stresses the importance of proper dye markers.

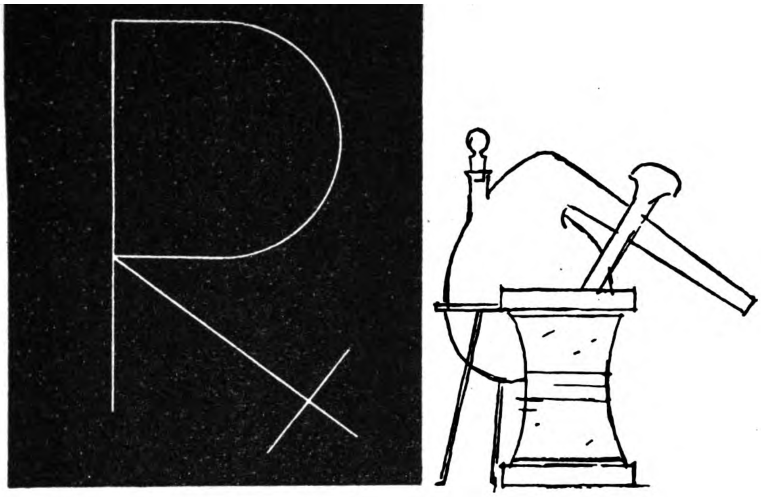
In this connection, the intensity of the dye is more important than the size of the dispersal area, Navy reports indicate. Since the life jacket Mae West dye marker packet is exhausted in a rough sea in 20 to 30 minutes and ceases to be a good target marker after an hour, it is preferable to conserve this signal until a rescue craft is known to be in the area and then disperse the dye as quickly as possible.

The Navy disclosed that, from the searcher's point of view, life rafts have the least power to attract the eye off-center from its point of fixation. Pi ported that one must be looking directly at t order to be able to spot them and effect resci

In many of the tests conducted off the sh California, many of the life rafts were spotte the air, lost to the searchers and never found unless immediate steps were taken to mark th ing location so that searching planes could re the scene. The Navy found that this is best plished by dropping smoke or dye markers from the raft.

As has been noted in countless rescue bulleti lished by air sea rescue facilities since the com ment of long water flights from Marianas b islands in the Pacific and the Japanese homela signaling mirror is the most important visual in searches conducted during daylight hours the survivor's point of view. The use of the ing mirror was responsible for the rescue o Allied airmen during the war against Japan.

The range of the mirror in sunlight is limit by the degree of atmospheric haze and the v of the searching craft to the mirror operator signal has frequently been picked up at ranges a as 12 miles, the Navy reports.



therapy after exposure to cold

ɔid rewarming of chilled survivors has long been considered dangerous. It is now be- ıowever, that in view of the results of the ces incident to World War II and the com- n them by outstanding American authorities, :ment of survivors after exposure to low tem- s may be formulated as follows:

:onscious, but breathing (this situation is likely · if rectal temperature is below 80.6° F.) the al rescued from cold water should be im- ly undressed and placed in a bath from 115° F. for 10 minutes, then dried with a towel ced in warm blankets. If the temperature : rise at a rate of at least 2° F. every 10 min- reafter, immersion in warm water should be l until the rectal temperature reaches 93° F. s considerable rise in temperature after re- 'rom the warm water, and there is no ad- to be gained from rapid heating once this ɿl has been regained. If a warm bath is not ɘ, warm water should be poured into the trouser legs and over the clothing and body, ırvivor should be carefully held under a warm

In any event, no time should be lost in ; treatment after rescue.

ıscious, the survivor should be immersed in :om 105° to 110° F. for 10 minutes, after ıme treatment may be carried out as for the ious person. Water heated to 115° F. is to a conscious patient and may cause some in chilled persons with rectal temperatures l° or 92° F. It appears likely that survivors conscious when rescued from cold water will often survive without the aid of the warm bath if they are merely dried and placed in light cradles or electric heating bags.

Survivors exposed to moderately cold temperatures for long periods should be rewarmed much more slowly, preferably by the use of heated blankets, electric heating bags or light cradles.

Survivors exposed to dangerously low temperatures for long periods should be rapidly rewarmed, preferably by a warm bath, until the rectal temperature begins to rise. More gradual rewarming is indicated as soon as the immediate danger from extremely low temperature has passed.

Massaging is to be avoided under all circumstances. Drugs, such as strophanthin, digitalis, metrazol, lobeline, coramine and alcohol are of no value. In fact the results of experiences considered reliable show them to be harmful.

Administration of 100 percent oxygen at atmospheric pressure should be advantageous by supplying dissolved oxygen not dependent upon hemoglobin dissociation.

Clinical thermometers do not register temperatures below 94° F. However, chemical thermometers are available aboard ships of many types (all of those having facilities for performing Kahn tests) and these may be used if ordinary precautions are taken to prevent breakage. Determinations of rectal temperature are of value in guiding therapy and, in addition, they constitute a very important part of the record of each survivor. Whenever possible, the temperature should be taken immediately after rescue while the warm bath is being prepared.

It is also urgently recommended that the temperature of the sea water at the site of rescue be determined and recorded in the survivor report.

According to Bazett, one important reason for the safety of rapid heating after abrupt cooling of short duration may be stated as follows:

Cooling is accompanied by reduction in blood volume which is achieved by general constriction of the vascular bed which in turn forces fluid into the tissues. During brief exposures, the fluid remains in the tissues and can readily return to the circulation when the peripheral vascular bed is again relaxed by warming. There is no need to avoid sudden rise in temperature and thus maintain vaso-constriction.

On the other hand, in long exposure much of this fluid may be lost from the body by diuresis, and there may be other adjustments in the fluid distribution in the body, which are as yet unknown. Persons so exposed usually are unable to obtain adequate fluid by mouth, and the fluid reservoir normally existing in the contents of the gut may be seriously depleted. Vasodilation abruptly induced in such subjects by rapid rewarming may therefore suddenly increase the vascular bed at a time when adequate fluid is not available to fill it. The blood volume cannot be adjusted to the enlarged vascular bed, and a condition similar to that of surgical shock is thus induced.

IDENTIFICATION PAINTING OF RESCUE CRAFT

Experience has shown that effective Air Sea Rescue operations often depend on the ability of individual rescue units and of the officer in tactical command to identify other units near or at the scene. This applies especially to distress cases in which rescue aircraft and surface craft have participated jointly. Occasional difficulties or failures in communications emphasize the importance of visual methods of identification. It is often of importance to persons in distress as well as to secondary rescue facilities, such as merchant and fishing vessels to be able to identify Air Sea Rescue craft immediately. Wide dissemination to the public should be made of the manner in which Air Sea Rescue aircraft and surface craft may be identified.

The following standardized markings are now in use by ASR seaplanes and amphibians. The top and bottom surfaces of wing tips, wing tip floats and upper surface of wing center section are painted international orange. The word "Rescue" and the plane's identification numerals or letters in black are centered on the orange wing center section. The hull is mark ensure identification from all angles. A 36-inch o band encircles the hull just forward of the tail asse On either side of the forward hull is a large o rectangle containing black identification numer letters. On the bottom of the hull, between th and the step, appear the identification numer letters. These are orange and edged in black.

Air Sea Rescue surface craft are marked as fo The tops of all deckhouses and upper outboard tions of their bulkheads and attached coaming bridge wings are painted, to a line 12 inches abo main deck level, with yellow striping. The in tional radio/visual call sign where assigned, or not assigned such identification call as may be nated by Air Sea Rescue Task Unit Commande indicated in black letters on this yellow backgr In general these letters will appear on both si pilot house and on one horizontal surface.

Air Sea Rescue airships may be identified by orange yellow horizontal and vertical fins, gondol engine nacelles, and nose battens. The word "Re appears on top of the bag and on either side the words "U. S. Navy." The Bureau number ap on either side of lower vertical fin and on upper su of both horizontal fins.

As a means of insuring better coordination be Air Sea Rescue planes, blimps and surface standard painting instructions have been direct use by Air Sea Rescue Task Units.

Detailed painting instructions are covered b following references:

AIRCRAFT;

ESF Air Sea Rescue Manual, under "Miscell Information."

SURFACE CRAFT:

ESF Letter ESF–93/H2(S)/S19–1/S82 Serial dated 8 August 1945 (with the enclosures below).

1. BuShips letter S82–3–(5)(58190–3) EN28/ dated 12 July 1945. BuShips specificatio Standardized Identification Painting for Ai Rescue and Bombing Target Boats, dated 4 1945.
2. ESF Serial 7854 dated 8 August 1945 "ES structions for Marking ESF ASR Vessels International or other Call Signs."
3. ESF Serial 7855, dated 8 August 1945 "ESF fications for Identification Painting of 165′ assigned Air Sea Rescue Duty."

AIRSHIPS:

CNO Restricted dispatch 311410 July, 1945.
CNO Restricted dispatch 041858 August, 1945.
CNO Serial 027734 of 26 June 1945.
CNO Serial 204434 of 19 July 1945.

eather bureau winsonde ogram

by B. C. Haynes, Chief of Observations Section, U. S. Weather Bureau. BS, MS, California Institute of Technology. Formerly: (1) Head of Technical Training Section of the Weather Bureau; (2) Air Safety Specialist in Meteorology, Safety Bureau, Civil Aeronautics Board; (3) In charge Aviation Meteorology Dept., Boeing School of Aeronautics. At present: (1) Member — Subcommittee on Deicing Problems, National Advisory Committee for Aeronautics; (2) Member—Advisory Council of the Air Safety Division of the National Aeronautics Association; (3) Member—Institute of Aeronautical Sciences; (4) Author "Meteorology for Pilots," Civil Aeronautics Bulletin No. 25.

e of the most notable contributions to aerial navigation and upper-air meteorology during was the development of radio direction-finding hich could be used in conjunction with balloon-radiosonde [1] transmitters to obtain the winds

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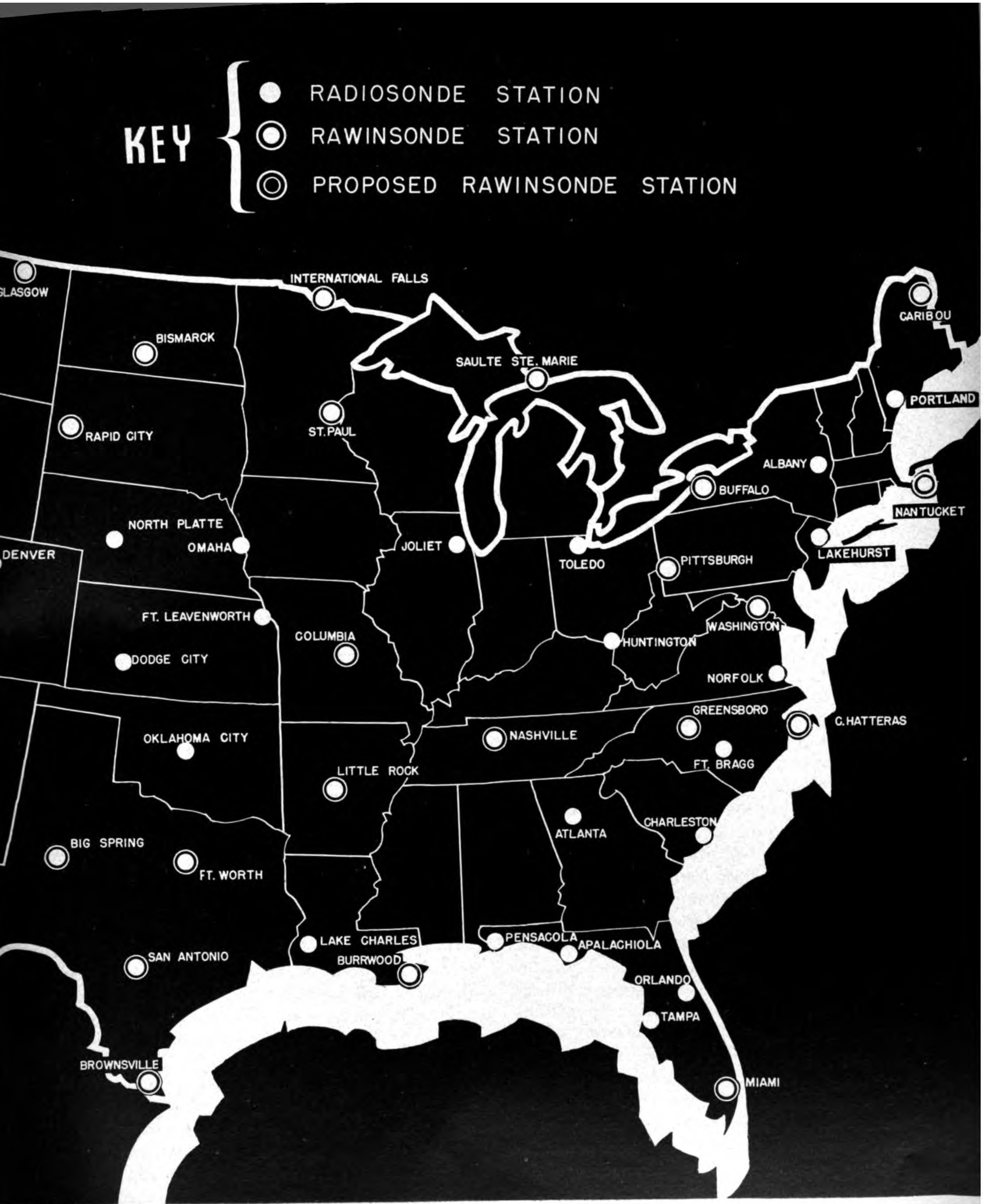
liosonde.—A combination radio meteorograph ansmitter which measures pressure, temperaad humidity.


KEY
RADIOSONDE STATION
RAWINSONDE STATION
PROPOSED RAWINSONDE STATION
GLASGOW
INTERNATIONAL FALLS
CARIBOU
BISMARCK
SAULTE STE. MARIE
PORTLAND
ST. PAUL
RAPID CITY
ALBANY
BUFFALO
NANTUCKET
NORTH PLATTE
OMAHA
JOLIET
LAKEHURST
DENVER
TOLEDO
PITTSBURGH
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C. HATTERAS
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FT. BRAGG
LITTLE ROCK
ATLANTA
CHARLESTON
BIG SPRING
FT. WORTH
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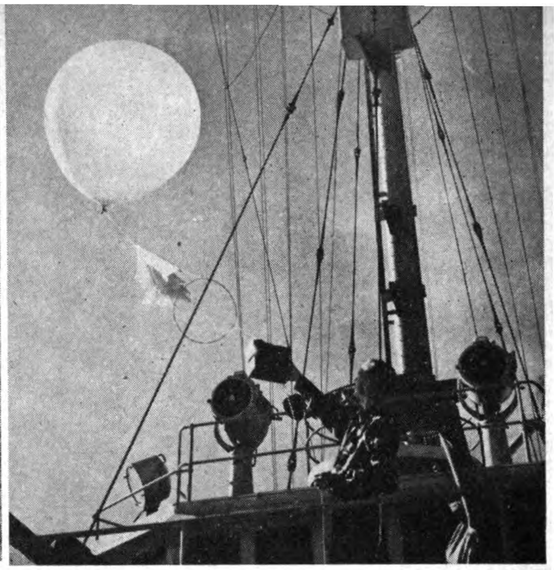
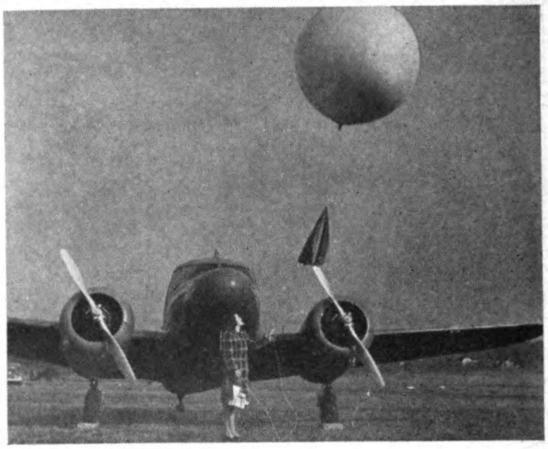
ORLANDO
TAMPA
BROWNSVILLE
MIAMI





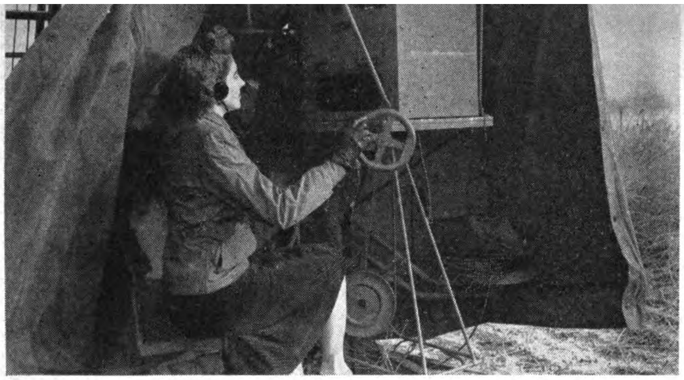
CR–658 direction-finding unit. ▲

diosonde being released by Weather Bureau observer on ▼
Coast Guard Atlantic Weather Patrol ship.

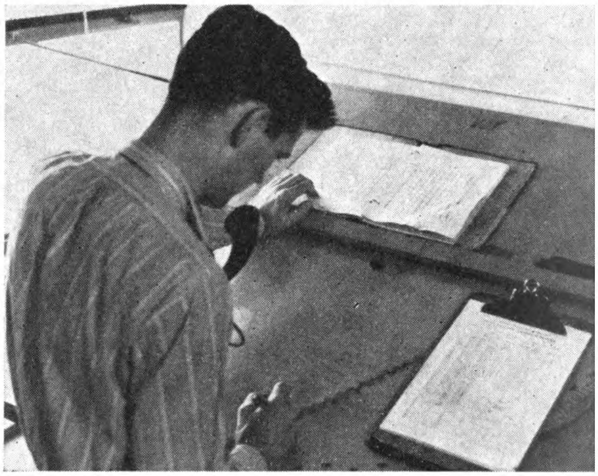
Radiosonde train ready for release. ▼

levels during all weather conditions. The n-finding equipment was developed by the Signal Corps and the Farnsworth Television dio Corporation, and is now being made avail- the Weather Bureau for use in its upper-air n. The principal components of the new ent are the radio receiver indicator with azi- nd elevation radar-type oscilloscope and an- designated as SCR–658 type. The Weather has been operating 76 radiosonde stations in ited States and its possessions, and on ships Atlantic Ocean, where upper-air observations perature, pressure, and humidity are made by a balloon-borne radio-meteorograph called a nde. This instrument transmits pressure, ature, and humidity signals on a frequency of egacycles to a radio receiver on the ground. gnal is automatically recorded, and values of per-air elements are obtained. At extreme the balloon bursts and the radiosonde de- o the surface of the earth on a small parachute. new program involves a radiosonde operating equency of 403 megacycles. This wavelength is suitable for direction-finding. The antenna of the SCR–658 may be rotated through the vertical and horizontal angles so that maximum signal strength will be indicated by the oscilloscopes when the antenna array is pointed directly at the ascending radiosonde. Elevation and azimuth angles may then be read on indicators at one-minute intervals. Direct computation of the altitude of the radiosonde may be made by pressure-temperature relationships, using the values transmitted by the radiosonde during its flght.

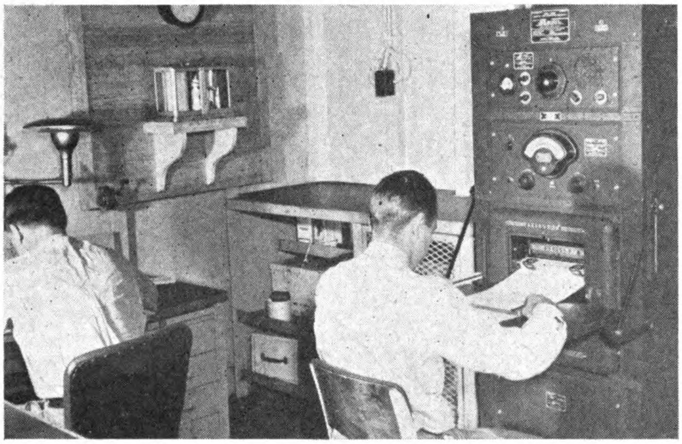
In actual practice, three observers working as a team are required to make the observation, compute the values, and code the message for transmission by teletype and radio at the scheduled times. One observer acts as the SCR–658 operator and is in general charge of the assembly of the balloon, parachute, and radiosonde train, and the actual operation of the direction-finding equipment. A radiosonde observer operates the radiosonde ground equipment and computes the pressure, temperature, altitude, and humidity data as they are received on the recorder. A third observer acts as the winds-aloft computer, and



◀ *Operation of SCR–658 radio direction-finding u*



Plotting the winds-aloft information. ▶



◀ *Radiosonde observer computing pressure, temper and humidity record.*

he must work in close cooperation with the operator of the direction-finding set and the radiosonde observer. Azimuth and elevation angles are telephoned to him each minute by the operator of the SCR–658 set, and altitudes are computed and given to him by the radiosonde observer as the flight progresses. Using these data he computes the position of the balloon with respect to the station at each minute-interval, and then obtains the wind direction and speed through the various levels of the flight.

The Weather Bureau's winds-aloft program has in the past been based almost entirely on the visual observation of pilot balloons by means of a theodolite. The network of pilot balloon stations now consists of 165 stations which make four observations daily. The use of rawinsonde[2] methods will make observations possible within and above cloud decks that would otherwise restrict observations by the visual method. The present program calls for the establishment d 1946 of rawinsonde equipment at 43 stations i United States, Alaska, and the Caribbean. T daily observations will be made beginning at 10 and 10 p. m. E. S. T., respectively. Followin complete list of stations at which the rawin equipment is to be installed this year accordi present plans announced by the Weather Burea

Buffalo, N. Y.; Caribou, Maine; Nantucket, M Pittsburgh, Pa.; Washington, D. C.; Greensbor Hatteras, N. C.; Miami, Fla.; Nashville, Tenn. Juan, Puerto Rico; Bismarck, N. Dak.; Huntin W. Va.; International Falls and St. Paul, M Sault Ste. Marie, Mich.; Albuquerque, N. M. Spring, Brownsville, Fort Worth, and San Ant Texas; Burwood, La.; Little Rock, Ark.; Grand tion, Colo.; Rapid City, S. Dak.; Columbia, Lander, Wyo.; Las Vegas and Reno, Nevada; land and Santa Maria, Calif.; Boise, Idaho; Gla and Great Falls, Mont.; Medford, Oreg.; Spo and Tatoosh Island, Wash.; Alaska: Barrow, B Fairbanks, Gambell, Kotzebue, McGrath, an Paul Island.

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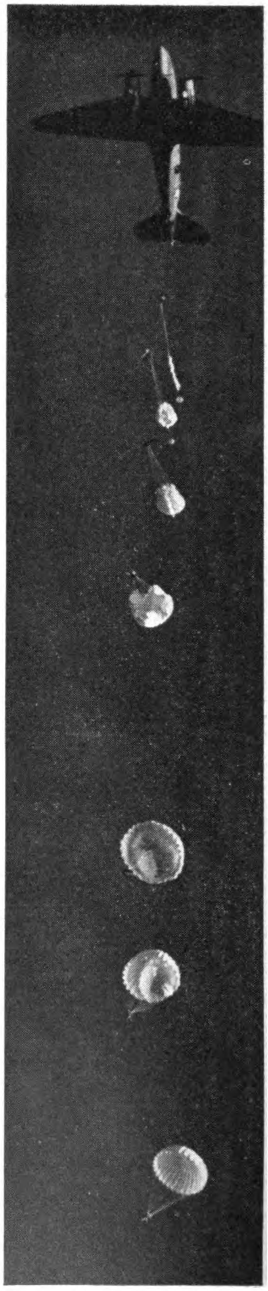
[2] *Rawinsonde.—Same as Radiosonde except that it also embodies a surface radio direction finder which permits the measurement of wind direction and velocity.*

aradoctors



e early American saga of the horse and buggy doctor has been streamlined;)obbin has been replaced by a parachute.

he problem of getting emergency medical aid to remote or mountainous dis- has always been a serious one. Fortunately, in the past, the fact that few ventured into these regions, unless as part of a well-equipped expedition made ong and dangerous rescue trips on horseback or afoot very infrequent.

oday, when sportsmen fly private planes to fishing and hunting grounds usly inaccessible, and commercial and military planes fly daily over the ugged and heavily forested regions of the continent, the need for emergency ıl aid is increasing rapidly. It is usually a question of hours, if not days, a ground crew can reach the scene of the accident in such districts, and those or days are too often the deciding factor between life and death. From this on evolved the paradoctor, the modern counterpart of the pioneer physician rove the horse and buggy to the end of the road and then set out on foot what aid he could to those in pain.

he general plan of operation of the work of these men can best be illustrated ewing a sample mission.

n October 14, 1945, the Second Air Force search and rescue organization ed a request from the U. S. Forestry Service in Missoula, Mont., to assist in ergency treatment and evacuation of an injured hunter in the Selway Primi- rea of Idaho. The man was reported to have had his arm nearly shot off unting accident. Capt. Amos Little, a paradoctor with the Second Air Force, mediately by plane with nine smoke jumpers of the Forestry Service. The l man was located by means of a smoke signal in the Little Goat Creek area. on a 6,500-foot ridge that had steep slopes dropping on either side. Capt. parachuted from the plane at 1,200 feet and landed approximately 15 yards where the man lay. The nine men of the U. S. Forest Service followed him while the crew remaining in the plane dropped a Stokes litter and other s.

he wounded man was in a critical condition. Emergency treatment was istered by the paradoctor. Evacuation had to be made over a 9-mile narrow path that permitted only two men at a time to act as litter bearers. One our stop was made in the middle of the trip to give the patient more morphine asma. The 9 miles were covered in about 6 hours.

t the Shearer Landing Strip the patient was placed aboard a waiting plane own over the mountains to a hospital in Missoula.

The origin of the paradoctor program in search and rescue was in the fall of 1943, at Buckley Field, Colo. Six volunteer medical officers from the Second Air Force stations and six medical officers from Arctic search and rescue squadrons went into training for rescue work in remote areas. Realizing the frequent necessity for a doctor at the scene of a crash, and inspired by a film on the U. S. Forest Smoke Chasers, they asked for parachute training and received it at Missoula, Mont.

The training at Missoula was under the direction of Mr. Frank Derry, chief parachute instructor for the Forestry Service. The initial indoctrination to parachutes and their function was conducted at Seeley Lake, Mont. The total course consisted of approximately 6 weeks' training of which 3 weeks were spent at indoctrination, physical training, and such practice problems as let-down (practice simulating release from a parachute hung up in a tree) and practice in problems of exit from the plane and proper exiting body position. The jump tower was used to simulate the exit and the free fall in the air followed by the opening shock. Jump training itself was conducted in the last 3 weeks of the course, and all jumpers were given 10 to 12 practice jumps during which they were instructed in procedures such as slipping, spilling, and steering the parachute so as to effect an accurate spot landing. The last 2 jumps of the 12-jump training program were timber jumps in which the parachutists attempted to land in trees high enough to force use of the let-down technique.

At the end of this training program the Second Air Force doctors were assigned to various stations throughout the Rocky Mountain Area in western United States. The Arctic search and rescue medical officers were assigned to stations in the Alaskan Division and Northern Atlantic Division of the ATC.

In order to best accomplish rescue missions, a control center and unit stations are maintained in which there are available at all times aircraft and pilots trained in the methods of conducting aerial searches. The paradoctors are stationed at strategic points throughout the mountain area.

The selection of personal equipment before a mission is important. Each experienced man is allowed his choice of clothing and foot gear.

Standard equipment includes a large pocket k
compass, and a waterproof match case often
around the neck with identification tags. Cont
medical kits depend upon the mission. Small s
instruments, dressings, bandages, medication, bl
chemical heat pads, and splints are usually inc
In the paradoctor's jumping suit is a large peg
which will carry a medical officer's emergency k
"Handy Talkie" radio (Radio Receiver and
mitter BC–721) so that they are readily av
once he has landed. The portable radio affor
mediate contact with planes circling overhead

The primary duty of the paradoctor is to rea
attend pilots who have been forced down, th
liver them to a hospital. The medical treatm
volved is usually the easiest part of this assig
the hard task is to move the patient over m
trackless terrain, along seemingly endless lak
streams, to a lake large enough to land an ampl
plane, or directly to a hospital. As a result, th
doctor practices physical training at all time
maintain jumping technique and physical con
the paradoctor and his assistants make at lea
parachute jump a month. Tree landings,
landings in velocities up to 30 miles per ho
night jumps are practiced.

Many dramatic experiences have occurred
work. Paradoctors have assisted in confi
cases where women were living in remote ar
from medical help; they have parachuted
hunters too badly wounded to reach medical
assisted; they have made night jumps to sea
wreckage and give medical aid to survivors of
that have crashed in mountainous areas a
hours before the ground crew was able to rea
scene. These and many similar incidents ill
the character of the paradoctor's work which
is often severe is never uninteresting.

At the present time, the tentative program
future of paradoctors is that they will becom
tional organization under the administration
tinental search and rescue units. Several
medical personnel who have engaged in this
work in a military status have expressed a de
cause of their training and experience to c
as a civilian. The opportunities to do full tim
as a paradoctor are few, but the chance to
time work will furnish an excellent way for t
sician interested and trained as a paradoctor t
tain his contact with this field.

flight surgeon who investigates aircraft ıshes in the field must pay particular attention ıstructing the physical status of the aircraft and during a crash.

ollowing facts must be known if a reliable on between the physical forces and the result-ies in a crash is to be made:

. Magnitude of force acting on the occupant.
. Direction of forces acting upon the occu-t.
. Duration of forces.
. The area of distribution of force.

the investigating flight surgeon should in-his report of every crash his best estimates of the velocity of the aircraft at impact, its angle and attitude, and the distance of deceleration.

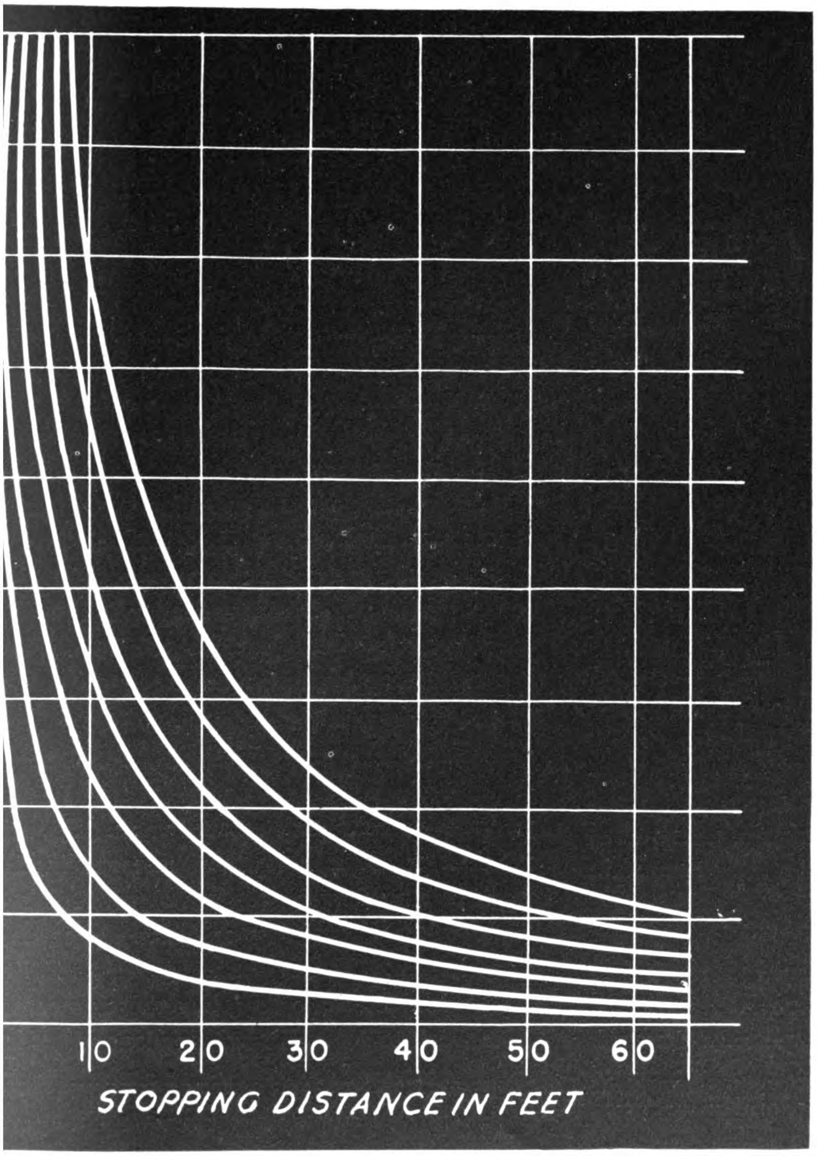
Magnitude of force.—The average force acting on an individual during a crash depends upon the total change of velocity and the time in which this change occurs. It may be computed by a formula in which the distance traveled during deceleration is used instead of the time because of the great ease of measurement of distances in the field. (Fig. 1)

When a moving body strikes an object, impact forces are applied to the body which if great enough may result directly in fatal damage.

Linear accelerations which can be tolerated parallel to the transverse plane of the body have been esti-

d R. Bierman, Comdr. (MC) USNR

physical principles in crash reporting



DECELERATION IN AIRPLANE CRASHES

EXAMPLE: Plane traveling an estimated 100 knots hits ground and slides 22 feet in stopping. How many G's is the pilot subjected to—

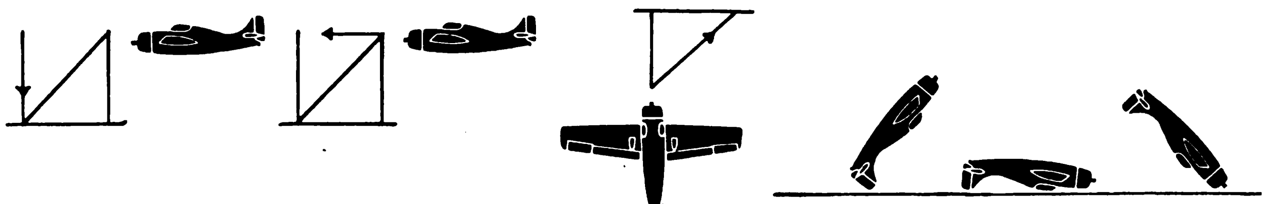
ANSWER: Go out along ease line to 22 feet and then up to the 100 kt. Curve from this point (Point A) go left to the ordinate and read the answer, 20. To find force on pilot's body multiply his weight by the number of G's. If the pilot in the above example weighed 180 lbs. the force on him would be 3,600 lbs.

mated as approaching 40 G for a duration of 0.01 second. German investigators report that impacts of 20 G from seat to head have been withstood without injury. With higher accelerations in this direction, vertebral fractures have occurred. The velocity of aircraft may be estimated by reconstructing the status of the plane in regard to attitude, altitude and pilot control at the moment of impact.

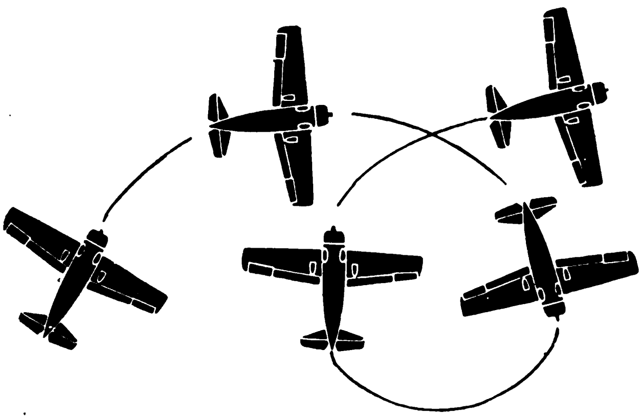
Direction of force.—The direction of forces applied to the occupants of crashing aircraft depends upon the attitude and angle of impact of the plane as well as the position of the occupants within the aircraft at impact. It is admittedly difficult to determine accurately the various components of the forces acting upon the individual during a crash. The position of the individual in the aircraft can usually be determined, however, and it then becomes possible to estimate the direction of the resultant force. It is

are accompanied by more serious injuries. possible, however, that in some cases a state of t rary physiological incapacitation (stunning) occur, resulting in death due to failure to escap the environment following the crash: for ex fire, drowning, or asphyxia. The direction of acting in aircraft crashes can be divided in vertical, horizontal and lateral components.] effects in the three axes should also be descri that the resultant direction may be determined figure 2.

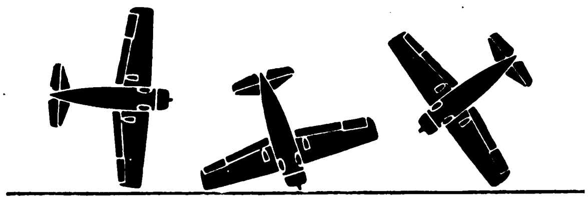
Duration of forces in a crash—"interval of eration".—The interval of deceleration may pressed as either time or distance. In most a crashes, the deceleration is irregular and the destructive elements during the period of decel may be irregular applications of force. Decel with fixed impact velocities, to afford the best



vertical component* • *horizontal component* • *lateral component* • *vertical ro



lateral rotation flat on ground



lateral rotation on ground (cartwhe

essential that the resultant force be fixed in three dimensions because a force applied tangentially to a body surface may produce a different lesion than that same force applied perpendicularly to that surface.

In most modern aircraft, the occupants face forward so that by far the greater number of injuries sustained are in the anterior coronal section of the body. Forces applied from above, such as are obtained when the plane hits in an inverted position,

for survival, should be of long duration resul small forces. The great majority of fatal a crashes involve short decelerative distances. T duction of force by means of a slight increase duration of deceleration is relatively greater a impact velocities since the force is inversely p tional to the stopping distance and is therefor sensitive to its variations when the force is The angle at which an aircraft strikes will, i

with the type of terrain, determine the dis- deceleration. Present information suggests angle of impact may be correlated with the ss of a crash in the type of injuries sustained. n exterior ballistics of large projectiles have ıat rapidly moving bodies which strike the ır water at an angle of less than 18 degrees horizontal usually ricochet. If they strike gle greater than 30 degrees, such bodies pene- l continue in the same direction in denser If such projectiles strike at an angle between 0 degrees, the subsequent course differs from ıal. This data may be applied to the analy- blems involved in aircraft crashes.

ft which strike at an angle less than 18 de- lass A).—The decelerating distance for rico- ircraft is great and the personnel injury and ate is low. Examples are crash belly land- er control and ideal carrier landings.

ft which strike at an angle of 18 to 30 de- lass B).—Aircraft striking the ground or an angle greater than 18 and less than 30 re often severely damaged yet the occupants uninjured. Crashes occurring at this angle quently been observed to destroy the landing /or wrinkle the fuselage even when the plane control.

ft which strike at an angle greater than 30 Class C).—Aircraft striking at angles greater degrees may be expected to have the highest ate of all crashes because they tend to have est distance of deceleration.

of Distribution of Forces.—It has been re- ıat two persons have survived decelerations of 200 G. In these cases, the area to which s were applied was large. However, impact probably transmitted through human tissue ıner characteristic for each tissue. In gen- larger the volume of tissue to which the ıpplied, the less destruction to be expected. greater the rate of increase of deceleration, localized will be the effect of the impact.

ESS SIGNAL FOR IERCIAL USE

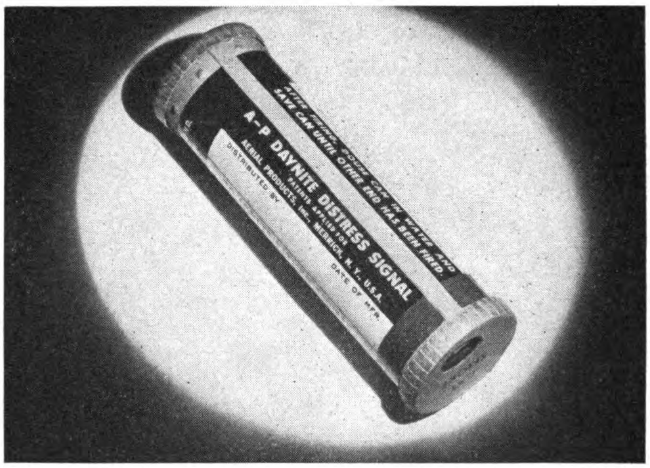
A-P Daynite Distress Signal unit has been to provide a practical, economical distress ır commercial air carriers, private pilots, n, fishermen and the maritime industry.

The unit is cylindrical in shape, is $5\frac{3}{16}''$ long and $1\frac{5}{8}''$ in diameter and weighs approximately seven ounces. The daytime signaling element produces an orange-colored smoke, with excellent visibility range, for eighteen seconds. The period of smoke emittance may vary slightly, according to atmospheric temperature. The night time element—which is a pyrotechnic candle—produces a red-colored light of 20,000 candlepower for a period of thirty seconds.

Complete directions for use of the A-P Distress Signal are given on the colored label. An orange-colored band around one end of the unit identifies the daytime signal, while the flare end of the unit—for night use—is designated by a series of embossed projections extending around the case, approximately $\frac{1}{4}''$ below the closure.

The procedure for using the signal is simple. First, having determined which end of the signal is to be used (smoke for day, flare for night), remove the paper cap which is glued to the original unit. Ordinarily, this cap should be removed before actual use.

Second, point the signal away from the face and yank the pull ring which will detach itself from the can, thus igniting the composition.



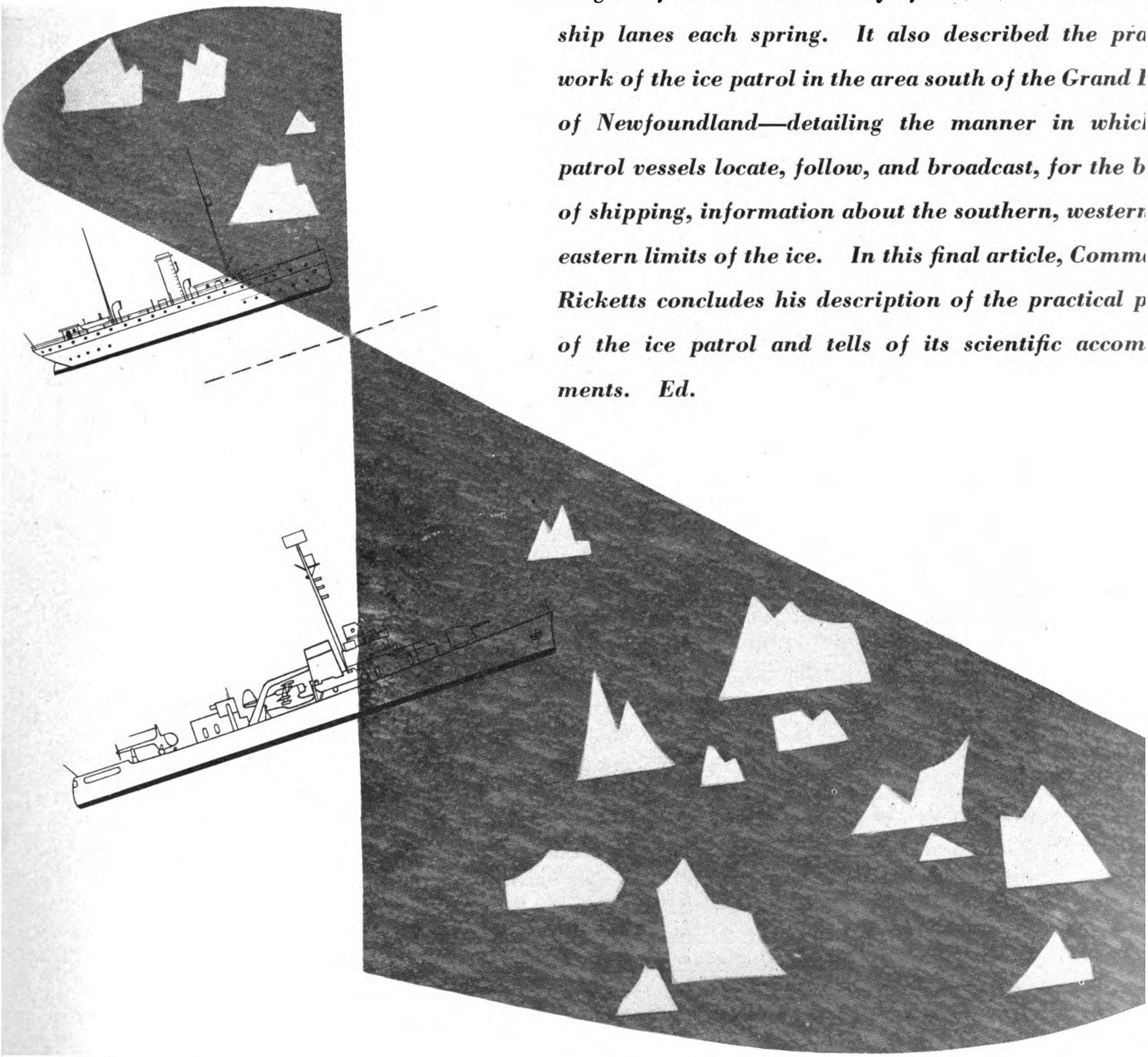
Note: If unable to remove the soldered cap in this manner, bring the pull ring down over the rim of the can and press down, using the ring as a lever to break the seal.

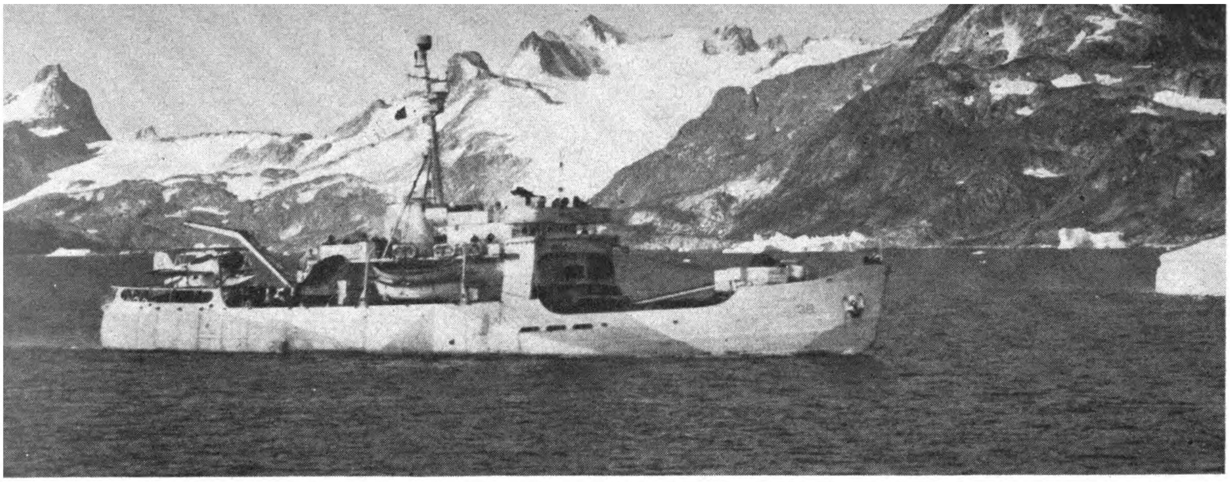
Third, hold the signal at arm's length, at an angle of about 30° from the horizontal, to protect the hand from possible hot drippings.

After one end of the signal has been used, douse in water to cool the metal. The signal may be retained until the opposite end has been used. Each section of the unit is waterproofed and insulated to prevent the transfer of heat from one section to the other.

iceberg Ho!

The first of this series of two articles by Commander [illegible] etts, which appeared in the March issue of the Bul[illegible] told something of the last glacial period and explaine[illegible] bergs drift south across many of the North Atlantic s[illegible] ship lanes each spring. It also described the pra[illegible] work of the ice patrol in the area south of the Grand I[illegible] of Newfoundland—detailing the manner in whic[illegible] patrol vessels locate, follow, and broadcast, for the b[illegible] of shipping, information about the southern, wester[illegible] eastern limits of the ice. In this final article, Comm[illegible] Ricketts concludes his description of the practical p[illegible] of the ice patrol and tells of its scientific accom[illegible] ments. Ed.





Part 2

0,000 square mile ice patrol area is so large ingle cutter on patrol can hope to cover but ortion of it. The 50 to 100 water tempera- rts coming in daily from vessels running on us tracks in use give fair assurance to the ssel that any ice near them will be sighted ted at least during periods of good visibility. days bergs can usually be sighted from a ship to 20 miles distant, depending mainly on ght, the height of the lookout's station and y of the atmosphere. Each reporting vessel he cold stream during daylight hours is de- pon to search out a good-sized strip for the sel. The wide spaces between the Canadian United States tracks through which practi- vessels pass are always doubtful areas. For n when it is possible with some degree of leave the southernmost ice for a time, it is ces that the patrol vessel generally tries to t between the longitudes where bergs may ed to be drifting southward.

incipal activities of the patrol are concen- an area to the southeast of Newfoundland e 50-fathom curve, between latitudes 41° N. N., bounded on the east by the 46th meridian e west by the 52d meridian. The most criti- which is within this principal region of activ- lly lies along the eastern and southern slopes and Banks south of latitude 44° N. between thom curve and a line 60 sea miles outside extending west to longitude 52° W.

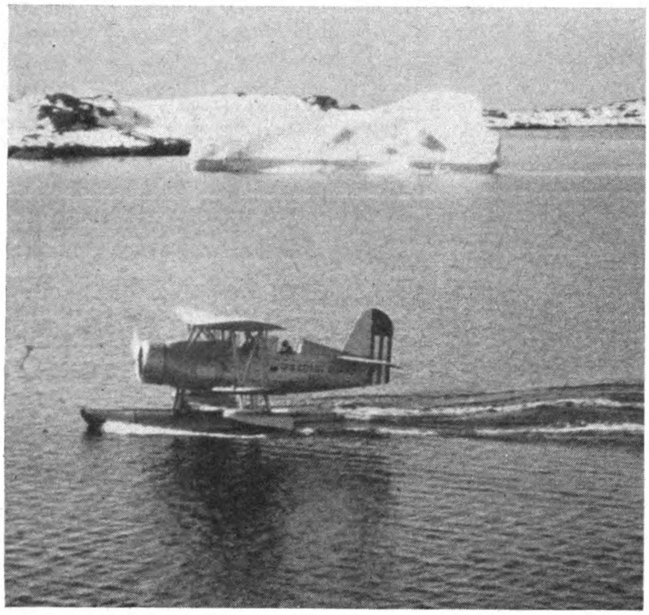
atrol vessel is almost always within the region of activity described above and must, visibility and weather permit, search out the rea for ice every 3 or 4 days, at least whenever bergs are in or are threatening to enter it. The critical area is so called because the bergs found therein are potential obstructions along the United States to Europe tracks B and C. Under normal conditions bergs entering this area from the north may within two days cross track C and within 3 or 4 days cross track B. It is in this region that most rapid changes in current take place, so it must always be watched.

However, in the final analysis the true critical area cannot be rigidly defined because its limiting lines are continually changing from year to year, month to month, week to week and even from day to day as the currents and winds carry the bergs through it. Experience of past years and study of the many records of ice and ice drifts in the published reports are of value in helping to determine it. The isotherm charts, changed and kept up to date from day to day, partly by means of observations made by the patrol vessel itself, but mainly by reports from cooperating vessels, also help the patrol vessel to detemine the critical area at any particular time, and show where search should be made for new bergs.

The isotherm charts aid materially in the problem of tracking down and relocating dangerous bergs lost during the extended periods of fog for which the region is famous, for when good isotherm charts are examined by experienced personnel fair estimates may be made of probable berg drifts. Good isotherm charts do not show the circulation as accurately, or in as much detail, as accurate up to date dynamic current maps, which will be explained later on, but they are a fine help, and are easy to make. Plotting the position reports of cooperating steamers is something that should be done even if the isotherm charts were of no value, because it shows at all times what vessels are going through the area and are available for emer-

gency assistance work should the need arise. If any vessel is noted to be approaching an especially dangerous area, it can be given an individual warning.

The annual reports of the Internation Ice Observation and Ice Patrol Service in the North Atlantic Ocean form the continuing story of development of this service. It has not been attempted in any one of these reports to solve all the problems or settle all the controversies of the ice patrol, but in each one it has been attempted to stress, develop and, if possible, to solve one phase of the general problem and to bring out the particular characteristics of the season in question. It is evident, therefore, that in order for the



reader of these reports to have a complete understanding of the patrol activities, he must consider not one but all of the annual reports and special bulletins. They form constituent parts of a homogeneous whole, and should not be considered merely as entities in themselves.

The mechanical problems presented in locating the ice and the technical problems in receiving and disseminating the necessary information were soon understood. The limitations and possible efficiency of the practical side of ice patrol have been dependent in large part upon the advances made in radiotelegraphy. The patrol vessels have been equipped from the start with the most modern radio equipment available and with well trained radio personnel so that the best possible service might be rendered shipping. It is the proper use of modern radio that makes it possible to operate an effective patrol.

Excellent cooperation through radioed reports is given by almost all ships passing through the patrol area. At the end of each season, letters of thar sent to masters of all these cooperating ships. ping companies, important libraries and specia terested persons throughout the maritime and sci worlds are mailed copies of the annual and : reports of the ice patrol as they are published.

Broadcasts are sent out by the vessels on patr times daily for the benefit of all ships crossing t patrol area. They give the patrol ship's positic weather and list appropriately the locations of al and other kinds of ice sighted or reported duri preceding several days. Special warnings reg probable berg drifts and describing areas kno have been unsearched for some time are freq included in the broadcasts. Special ice repo garding possible ice along their tracks are gi individual ships upon request. Great care is that no report is ever sent out stating absolutel there is no ice in any area because there is alwa possibility that unreported bergs and growler exist.

In addition, the location of all ice sighted a ported is sent several time daily on regular schedules to the United States Hydrographic Of permit them to broadcast detailed ice reports Navy radio stations and to publish them in hydrographic bulletins. Weather reports are sen also relayed from cooperating vessels, to the U States Weather Bureau to enable them to p better ocean weather forecasts. Close coopera maintained by the patrol by radio with Car Government officials concerned with maritime a

The patrol vessels themselves have adv almost as much from those making the early p as have the methods of handling the practical m of the patrol itself. The earlier vessels were sn more uncomfortable, and of such limited cr radius that but little effective searching for ice be accomplished. Larger and more modern ty cutters have become available through complet new construction programs. The best Coast (vessels available have always been assigned t patrol because of the importance of the work.

Weather in the ice patrol area is notoriously s the first 2 or 3 months of the season, so the available vessels are essential if more is to be a plished than lying to in gales and acting as a floating broadcasting station. The last 2 or 3 m of the patrol the winds gradually become gentl the average air temperature over the cold water up slowly, from near freezing to the 40's and 50' is then, however, that the long periods of (

most often hamper search for the southern-
s. It is a fallacy to think that the ice patrol
counter extremely cold weather. When the
sel is in or near the Gulf Stream, the air
res are often higher than those at New York
igton, especially during the first months of
son.

cruising speed should be available at all
ng periods of good weather to permit effec-
n for ice. Such search is carried out during
iours only. During the night, and during
poor visibility from fog and storm, the ice
ssels normally drift, because bergs cannot
seen, even on clear nights, when more than
uarter of a mile away except when bright
or other favoring factors improve their

patrol vessels always stand ready to give
to vessels in distress, to render medical ad-
idio or to render medical assistance when
on, and to destroy derelicts and other float-
rs to navigation. These additional duties,
can be prosecuted only when they do not
with the primary duty of the patrol, which
te the southernmost ice infested area and
ly disseminate ice information to everyone
.

y to an erroneous conception widely held
iblic as a result of newspaper reports and
or ice patrol pictures written by imagina-
ters and editors, the ice patrol vessels do not
ny bergs by gunfire, thermit, dynamite, or
large number of experiments with such
ve been carried out, but they did not prove
y successful for practical use. Several
f 6-pounder or even three-inch ammuni-
est, usually serves only to bring down into
few tons of ice fragments. The weight
s a negligible quantity compared with the
ne average berg. Use of wrecking mines, if
o be at all effective, requires that the bergs
d from a ship's boat and that the charges
lly placed. This is a hard and dangerous
do under the most ideal conditions, and a
mpossibility in the case of most bergs. The
e involved is not worth the meager results
ght possibly be obtained, so the patrol simply
the southernmost, or the most dangerous
il they melt. Then it concentrates on the
erous berg, or group of bergs, which menace
ship tracks.

covered in a general way most of the practical features of the international ice patrol, let us now consider the scientific work that has been done, and endeavor to evaluate the benefits which have been derived from it. Taken as a whole, the scientific program has often been pointed to as one which has netted successful and gratifying results. Before the days of the international ice patrol, the detailed oceanography of the deep waters of the western North Atlantic, north of the southern limits of the ice patrol area, was little known. Now, thanks largely to the work of the ice patrol, the whole area, even in its least frequented parts, is comparatively well known oceanographically. Wholly apart from its value as pure science, and as good general information to have about the world we live in, this knowledge and the "know how" of obtaining information concerning its physical phases, means additional power to the ice patrol to make its practical work more effective.

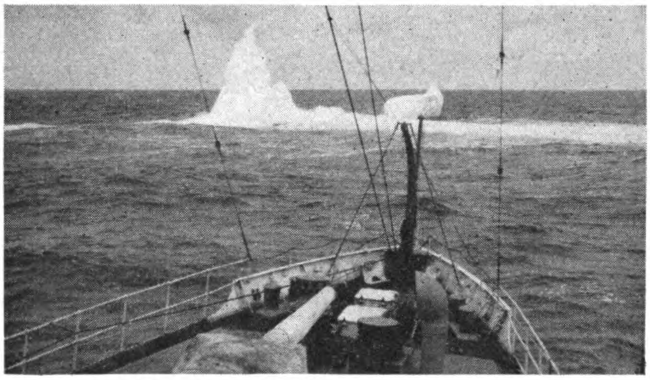
The scientific investigations have been chiefly oceanographical and meteorological in nature. Other lines of research conceivably of aid in the solution are studies of bird life distribution and of the distribution of fish and marine life in general. Many of the earlier investigations may seem far afield from the major problems of delineating the limits of the ice area, and of foretelling the drift of the bergs. But, as it was early realized that ocean currents were the controlling factor in the movement of the bergs, all these diversified studies were pursued in the hope of finding some indicator which would reveal the details of the complicated current system around the southern end or "tail" of the Grand Banks. Some such indicator was necessary because the technique had not yet been developed allowing for the construction of dynamic current maps at sea. Marine bird life and plankton distribution were investigated in the hope that one or both might show, either by their scarcity, abundance, or character, the presence of arctic, berg-bearing water. However, because this work produced no results of direct value, it was discontinued.

Attempts were made to determine the changing current system by means of current meters. Various types were used, but all were useless except when the patrol vessel was in shoal water and could be anchored. However, they did provide excellent information about the circulation on the Grand Banks themselves, which is largely tidal, but giving no clue to the major sustained ocean movements in the deep water carrying the bergs southward, this line of investigation was also dropped.

Observations of the upper air currents were started soon after the inauguration of the patrols, by means

of kites carrying recording meteorographs, and by pilot balloons. Important meteorological data were thus obtained, and at the same time the causes and character of the famous Grand Banks fog were thoroughly studied. Meteorological data still play an important part in the patrol program.

Each year, reports on the average barometric pressures of the winter months from a number of shore stations in the region of Davis Strait and Baffin Bay are used by the Coast Guard in making an annual forecast of the number of bergs that will drift south of the 48th parallel during the following ice season. Barometric gradients determine wind directions and velocities, and so influence temperatures. The surface winds have a strong effect on the drift of pack ice, but do not have much influence on drifts of deep draft bergs, except indirectly.



▲ *A patrol vessel passes close by a tabular berg. A new water line is being eaten in around this berg, and as it goes deeper, overhanging pieces of ice will fall down keeping the sides above water roughly vertical.*

The data from the Major Marine Bulletin of the U. S. Weather Bureau, together with weather reports from ships in the ice patrol area, are used by the vessel on patrol to construct weather maps twice a day. The resultant forecast is used in planning the patrol's search for ice for the next two days.

Efforts were also made to develop a method for the detection of bergs ahead of vessels, in fog or darkness. The ice patrol, with the use of an electrical resistance thermometer, graduated to one-hundredth of a degree centigrade, attempted to record typical temperature changes upon approaching bergs. Although the experiment was repeated many times under varying conditions, no definite trend could be established. The conclusions reached were that the temperature effects of melting bergs were less pronounced than the normal minor fluctuations of the temperature of the sea surface itself, therefore could not be used as a reliable index of their presence.

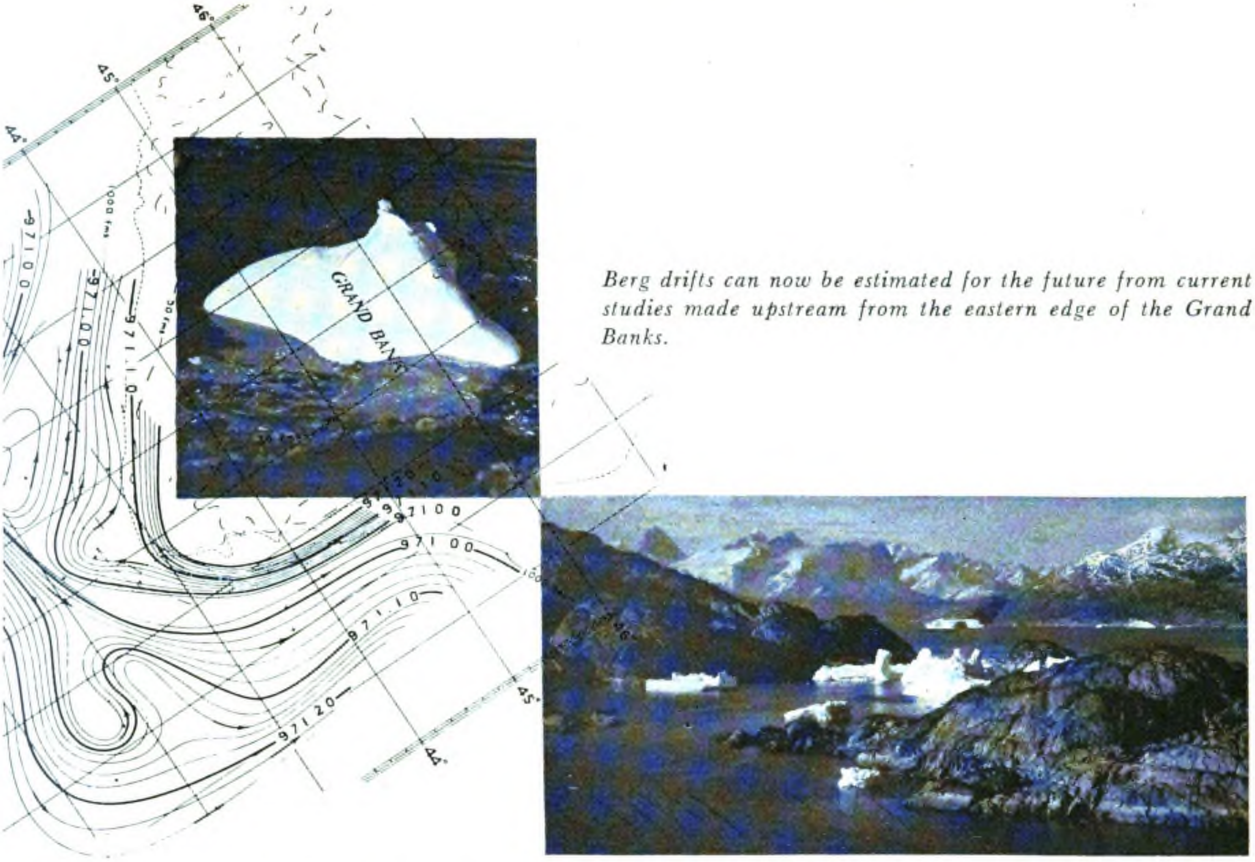
It was also suggested that bergs might be de by a subsurface echo sound device similar t which was then being developed commercial sounding purposes. The cooperation of the i trol was important during the early developm echo sounding. Because of limitations of equip no worthwhile results were obtained with berg the apparatus proved excellent for sounding pu The ice patrol vessels have taken many thousa well-located echo soundings, which have been ch occasionally by wire measurements to insure acc The soundings have rather thoroughly develop underwater contours of enormous sea areas o Grand Banks, Newfoundland, Labrador, Baff land, and Greenland. Only occasional sca soundings here and there had previously been in the greater part of this area. Good delin of the basin contours was a distinct contribut several branches of geology and permitted t patrol itself to pursue a more intelligent study ocean currents and probable ice drifts.

Modern echo-ranging equipment develope ASW will detect most large bergs. Its limitatio even more pronounced, however, than for subm detection due to the varying reflecting surface bergs.

Too much credit cannot be given to those c of the Coast Guard who conducted the early i trols in 1913 and 1914. It was due to the mediate grasp of the situation, intelligent inter tion of conditions and low percentage of erro conclusions that the many problems confronti patrol were realized and vigorously attacked. complete solution of these problems has been t of the ice patrol over its entire period of servic has been noted, lines of investigation which s no definite results after a fair trial were q dropped. Those that gave results were con and subjected to careful study.

The ice patrol has, on the whole, been for in the type of leadership available througho years, in the Interdepartmental Board at Wa ton, D. C., which helps the Commandant, Coast Guard, to determine general policy relat the patrol and in the commanding officers of t trol ships and their assistants. Excellent jud has usually been a noticeable characteristic levels. It is generally conceded that right de have almost always been made and the best u been made of all the means available to the patr

A notable organizational advance was made 1920 when an ice observation officer or oc



Berg drifts can now be estimated for the future from current studies made upstream from the eastern edge of the Grand Banks.

ıs he was often called, was detailed to special- atrol work. This officer, assisted by one or isted men, remained at sea throughout the eason, transferring from ship to ship as re- He acted as a technical assistant to the ıding officer of the ship on patrol. This as- continuity of contact with the ice situation ıiformity in the preparation of the broadcasts, ːcords, and scientific studies from year to year. st ice observation officer was Edward H. ıow a Rear Admiral in the U. S. Coast Guard. ined a world wide reputation as an oceanog- :hrough his work with the ice patrol during ıle 1920's.

Admiral Smith applied a boundless energy :rest to the early researches in physical ocean- , because his early studies forced him to the on that it would be through this division of that the most satisfactory results could be ł. He went abroad between several patrol and studied under the leading European raphers so that he could introduce the most d and accurate methods into the ice patrol Ice Patrol Bulletin No. 14, of 1926, entitled ctical Method of Determining Ocean Cur- embodies the latest and best methods which ł develop at that time. This publication still forms the main basis for the method of mapping ocean currents, which has become one of the most useful tools of the ice patrol.

In 1928, Rear Admiral Smith commanded the *Marion* expedition which made the first exhaustive oceanographic survey ever made of the waters between Baffin Island and Labrador and Greenland. So successful and fruitful was the *Marion* expedition that in later years a number of other post patrol season oceanographic and ice observation cruises were made by the *General Greene,* another 125-foot Coast Guard patrol boat, specially equipped and fitted out for oceanographic work. These later cruises extended into the same waters, but none have been so comprehensive as the *Marion* expedition. The scientific results of the *Marion* expedition are published as Coast Guard Bulletin No. 19, issued in three separate volumes.

Several hundred oceanographic stations were occupied during the *Marion's* 1928 cruise. At each such station, as at each one taken in and about the critical area for the immediate benefit of the ice patrol, water samples were obtained from a number of predetermined levels. The temperature of the water at each level was obtained with special protected, reversing thermometers. The salinity of each water sample was measured aboard ship by means of

a remarkably accurate electric salinometer, developed especially for the ice patrol by the U. S. Bureau of Standards.

Speed and direction of oceanic circulation can now be actually plotted in detail with an accuracy that depends upon the judgment and care with which the oceanographic station work has been done, and upon other limiting factors. Of course, it is easier to occupy the stations and to determine accurately their locations, when they are taken during moderate weather with good visibility, than during fog or storm. When the weather becomes extremely bad, the taking of reliable stations becomes impracticable.

Actual berg drifts confirmed the results obtained by the early current calculations made by physical oceanographic methods about the Grand Banks during the ice patrol seasons of 1926 and 1927. Similar current maps had previously been made in European waters mainly for fisheries investigations. However, the salinities were determined and the dynamic calculations made in the laboratory, after the conclusion of each cruise. The international ice patrol pioneered the calculating of these current maps within hours after the completion of the last station of the group and made the current maps immediately. The ice patrol needed results for immediate use at sea, not alone for later study. New methods were developed, as necessary, to speed the work, proving again that necessity is the mother of invention.

From the temperature and salinity values at each level at a station, the density of the sea water can be found. Then by use of well-known formula, the dynamic height of the sea surface above a predetermined base level is obtained for each station. All this, as well as the theory of ocean currents, is explained in U. S. Coast Guard Bulletin No. 14.

When a number of stations are occupied and calculated, current maps can be drawn that bear some resemblance to weather maps. The meteorologist weighs the atmospheric column with barometers and can, when necessary, estimate surface wind velocities from the differing pressures at different stations; so the physical oceanographer, in effect, weighs the water columns at stations by his observations and computations and, using the results, can calculate ocean current velocities. There are many differences between the methods of the meteorologist and oceanographer. Weather observations are made from the bottom of the compressible gaseous ocean of the air, while the oceanographer must drop his instruments down from a vessel floating on the upper surface of the almost incompressible liquid ocean. Strong ocean currents are confined to the upper layers, the bottom waters being cold and almost still. Th tom layers of the atmosphere, however, are ι warmer than those higher up and we know th far from quiet every time the wind blows. No standing the many differences, the oceanic circu is in principle much like that of the air, and i erned by similar laws.

So long as only two Coast Guard cutters co used for ice patrol, the making of current m the ship actually on patrol was hampered by the necessity of remaining with the southernmost ic searching for additional bergs in the critical In 1931 a change in the international conv under which the ice patrol operates, permitted t of a third patrol vessel. After that, the 12 patrol vessel *General Greene* was regularly primarily to make periodical current maps of c areas for the benefit of the major patrol vessel out the broadcasts and carrying the senior ice officers. This oceanographic vessel also prov tremely useful for making ice and surface temperature observations in key areas that we being covered by the major patrol vessel, or l operating ships.

The results from the use of three vessels, a the detailed current maps prepared on the *G Greene,* were so valuable that the continuance plan was assured after the first trial season. It small oceanographic vessel which is frequentl to make the post season ice observation and ographic cruises to the north of the ice patro after the ice ceases to be a menace there.

Long before World War II forced the disco ance of regular ice patrols, a high degree of pr and competence had been attained by the o graphic staff on the *General Greene* in making c surveys. The temperature measurements of years are considered accurate to within .01° stead of .1° C. as in the case of the earlier st Refinements were developed in other directi fast as experience could point the way. As a it is now actually possible, by means of the dy oceanographic calculations, to determine not o velocity of the currents with comparative acc but the number of cubic meters of water per s flowing in any ocean current across which a l stations has been taken.

When the above calculation has been mad possible to estimate the actual amount of heat the current is transferring from one portion globe to another. Thus, not only can the p

apher, for all practical purposes, weigh the vaters of the ocean as in fine balances; he can :k upon the hot water heating systems and ng systems of this planet like the engineer of uilding. The oceanographer is at the same tage as the meteorologist, however, in that he observe and make predictions. He cannot onditions he does not like.

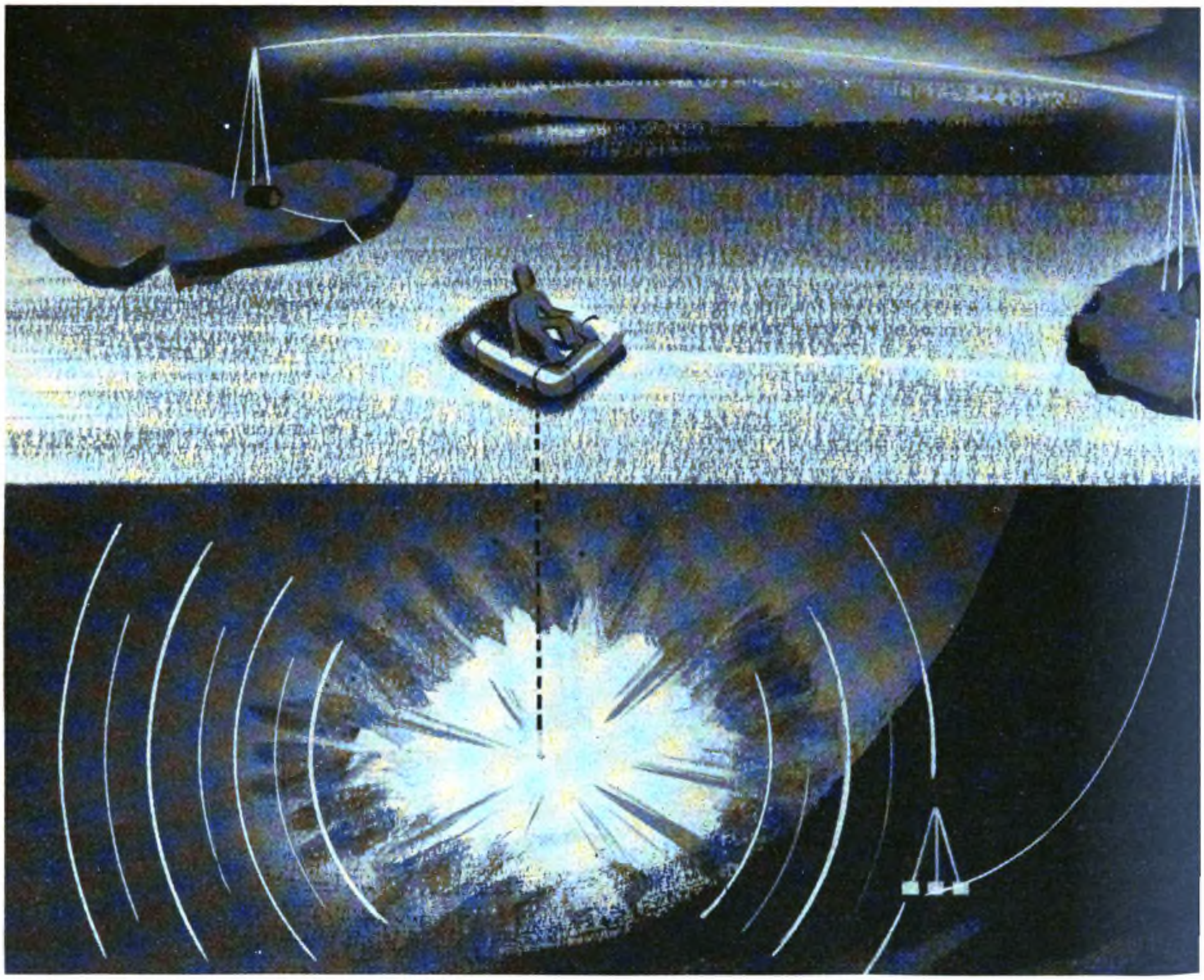
hat the volume and speed of ocean currents neasured almost as easily as is the flow of actual measurements on shore, it can be :ed how ocean current speeds, floods, and gs, when determined, can be used to estiure berg drifts. Current studies made upff the eastern edge of the Grand Banks can ised to determine what will probably occur outh, that is, downstream, later on. Current good for 7 to 10 days, once they are made, ing a much longer useful life than weather The oceanographic work has been found helpful to the patrol authorities when they g, as they must each year, to set the date ich the patrol may be terminated with le safety.

; World War II, no regular ice patrol has ducted and no Ice Patrol Bulletins have been l, but the time has been by no means lost. il to other missions much hitherto imprac:e observation and related work has been ut Greenland and to the southward, by surels and by aircraft. This important work netimes in areas formerly little observed, will be summarized and published in the report ternational ice patrol for the season of 1946. been determined that the international ice ll be resumed in 1946 and it is expected that for observation purposes will be coordinated rst time, to assist the surface vessel on patrol. will prove a tremendous boon to the patrol. l be especially valuable if their radar proves of locating the bergs through the Grand g. Their use was considered many years at first they were not far enough advanced, planes and pilots were not available. Now, the war, they should both be available in numbers and with greater experience. As d of January 1946 no definite arrangements et been made for the 1946 patrol, all plans g more or less in a formative stage.

We may confidently expect that International Ice Patrols of the future will be more effective than those of the past. The great advances made during the late war, not only in the field of aviation but in such other sciences as loran, radar, underwater acoustic ranging, communications, and navigation will be readily applicable to their work. The Coast Guard is keeping abreast of all developments and will apply every known advance to further the work of the patrol. It is probable, therefore, that fog and storm during the hours of darkness will not, in the future, cause the patrol to lose complete contact with the southernmost ice as was frequently the case in the past.

Notwithstanding the progress that has been made and the hope of better results in the years to come, it would not be proper to close this article without sounding a note of warning. Men and machines are fallible. So far as ice patrol is concerned, darkness, fog, and storm have not yet, and may never be entirely conquered. Those most closely connected with the patrol see most clearly its limitations. That is one reason why they have striven so hard through the years for improvements.

Just as the best system of traffic laws and police cannot guarantee entire freedom from automobile accidents along a State highway, so the best possible ice patrol of the foreseeable future cannot assure complete safety from the ice menace about the Grand Banks. Even the use of radar by the ice patrol and by commercial vessels will not eliminate all danger. It is incumbent upon the masters of all vessels passing through ice regions to exercise due care during times of darkness and low visibility. The mathematical probability of a vessel's colliding with a berg along the United States-Europe tracks, where bergs are never numerous, is small, and with more efficient ice patrols it will become yet smaller. Nevertheless, steamship masters must be made to realize that a residue danger still exists. As we have seen, bergs often move rapidly and in unpredictable directions. Thus, there always exists the possibility of unreported ice in certain areas. This danger is greatest near the end of long periods of storm or fog. Masters cannot, to maintain schedules, hurtle at high speed through darkness, fog and thick weather in the ice regions with complete assurance of immunity from collision with ice.



Long-range underwater sound project SOFAR developed to locate survivors a[t sea]

A long range underwater sound system for use in locating air and ship survivors far at sea has been developed by the Navy in cooperation with the Woods Hole Oceanographic Institution, Woods Hole, Mass.

The system, called "SOFAR," utilized a TNT charge dropped by survivors at sea and sound receiving equipment at stations ashore. Survivors in a life raft drop the bomb, constructed to explode at a depth of 3,000 to 4,000 feet. (Fig. 1) Operators of three widely-spaced shore stations, using hydrophones at the same depth, pick up the signal. By comparing the times when the signal is received and then referring the differences to special charts, they are a[ble to] plot the position of the explosion within a fev[w min]utes after the most distant station hears it.

While it is planned that the detonating cha[rge be] carried as an integral unit of life raft equipmen[t, con]sideration is also being given to a method for dr[opping] the charge from an airplane before ditching. [Then] if personnel injuries or other circumstances p[revent] reaching or using the unit in the life raft, the signal will still have been given.

Survivors can be located within a square r[mile at] sea, as far as 2,000 miles from shore station[s]

ıs to cover the general area between the ast and Hawaii are expected to be completed ıer. The sound transmission, which is the ıe Sofar system, is unaffected by terrestial or gnetic disturbances, such as are any of the rrent methods of signal communication.

ıew system's name, "SOFAR," comes from al letters of the phrase Sound Fixing and . "SOFAR," depends on an underwater ıne, the existence of which was confirmed as duct of wartime submarine detection studies ɔn for the Navy's Bureau of Ships by Dr. Ewing, then director of research in physics Woods Hole Institution, and now professor ogy at Columbia University. Professor studies demonstrated that, as the result of a g tube" effect, sound travels amazingly far pth zone between 2,000 and 6,000 feet.

g tests conducted in the Bahamas, sound ıe zone was heard with useful intensity when ıerating ship, the U. S. S. *Muir,* dropped s far away as Dakar, Africa, 3,100 miles e Atlantic. No other man-made sound has ırd more than a small fraction of this dis- However, at a depth of 600 feet the bomb At a depth of 600 feet the bomb explosion can only for distances of 100 to 300 miles.

ıund lasts less than a second at the point of sion, and is heard for 24 seconds 2,000 miles The signal at the hydrophones is likened to a um building up to a sharp finale. The up sound travels by "multiple paths" back and oss the zone, the finale travels directly but The sharp concluding sound permits time ıent within one-tenth of a second.

radio contact between shore stations, close on of the sound's times of arrival is possible, me differences are applied to hyperbolic ıd the position of the explosion plotted.

-cost five-pound bomb is being designed by au of Ordnance for installation on life rafts. ıloded by the effect of increasing pressure. ıe Bahama tests, hydrophones were improved ıcy will operate dependably at 4,000 feet, a which they had not been subjected.

d to assist rescue at sea, "SOFAR," may also navigational aid for ships. It is probably or air navigation, since as much as 40 minutes between dropping the bomb and obtaining Sound travels through water at a speed of about 5,000 feet, less than a mile, per second. It takes 20 minutes to go 1,000 nautical miles.

"SOFAR," is expected to be very useful in the Pacific, where the great overwater distances make air-sea rescue a serious problem. Its installation there is simplified by many volcanic islands, their steep underwater slope making possible the placing of hydrophones at the proper depth with short runs of cable.

The necessity for deep water and uninterrupted great circle paths between bomb and receiving stations are two disadvantages. Another is that the sound zone may not be well defined in and near the Arctic and Antarctic, a factor which is to be studied. However "SOFAR" can cover much greater distances than Loran or radio direction finders with accuracy comparable to good celestial navigation.

Stations will be set up for the immediate installation on Kaneohe Bay, near Honolulu, on the Farallon Islands off San Francisco, and on another island off the west coast of North America. There are Loran stations at these points and it is anticipated that "SOFAR" equipment usually will be installed with Loran so that the same personnel can maintain and operate both.

"SOFAR" also is expected to be applied in ocean geophysical work to locate underwater volcanic explosions and shoals. Location of shoals is ascertained by the shielding effect they exert in the path of the sound.

The Navy's Underwater Sound Laboratory at New London, Conn., directed by Commander J. B. Knight, USNR, played an important part in developing and testing equipment. The installations in the Pacific will be supervised by the U. S. Navy Electronics Laboratory, San Diego, Calif., with Capt. P. W. Hord, USN, as director.

The work of the Woods Hole Institution was carried on under contract with the Bureau of Ships and the office of Scientific Research and Development. Dr. Ewing's assistants included J. L. Worzel, J. A. Peoples, R. J. McCurdy, N. C. Steenland and D. E. Kirkpatrick. Contributing to the experiments was the Coast Guard ship U. S. S. *Valor,* Lt. D. T. Parsons, USCG, commanding. The various activities coordinated by the Underwater Sound Section, Bureau of Ships, Washington, D. C., were under Lt.-Comdr. E. L. Newhouse, USNR, and Lt. Comdr. W. C. Sands, USNR.

The zone through which sound travels great distances under water is created by the joint action of temperature and pressure on its speed and by the

resultant bending of sound waves back into the zone. When the bomb explodes well within the zone, or channel, much of the sound is confined there by the bending of these sound waves at the top and bottom of the channel. The sound continues to travel in these limits as the result of an effect like that of a "speaking tube." Sound originating above the zone is absorbed by reflection from the surface and by bubbles due to waves. Sound below the zone is absorbed by the sea bottom.

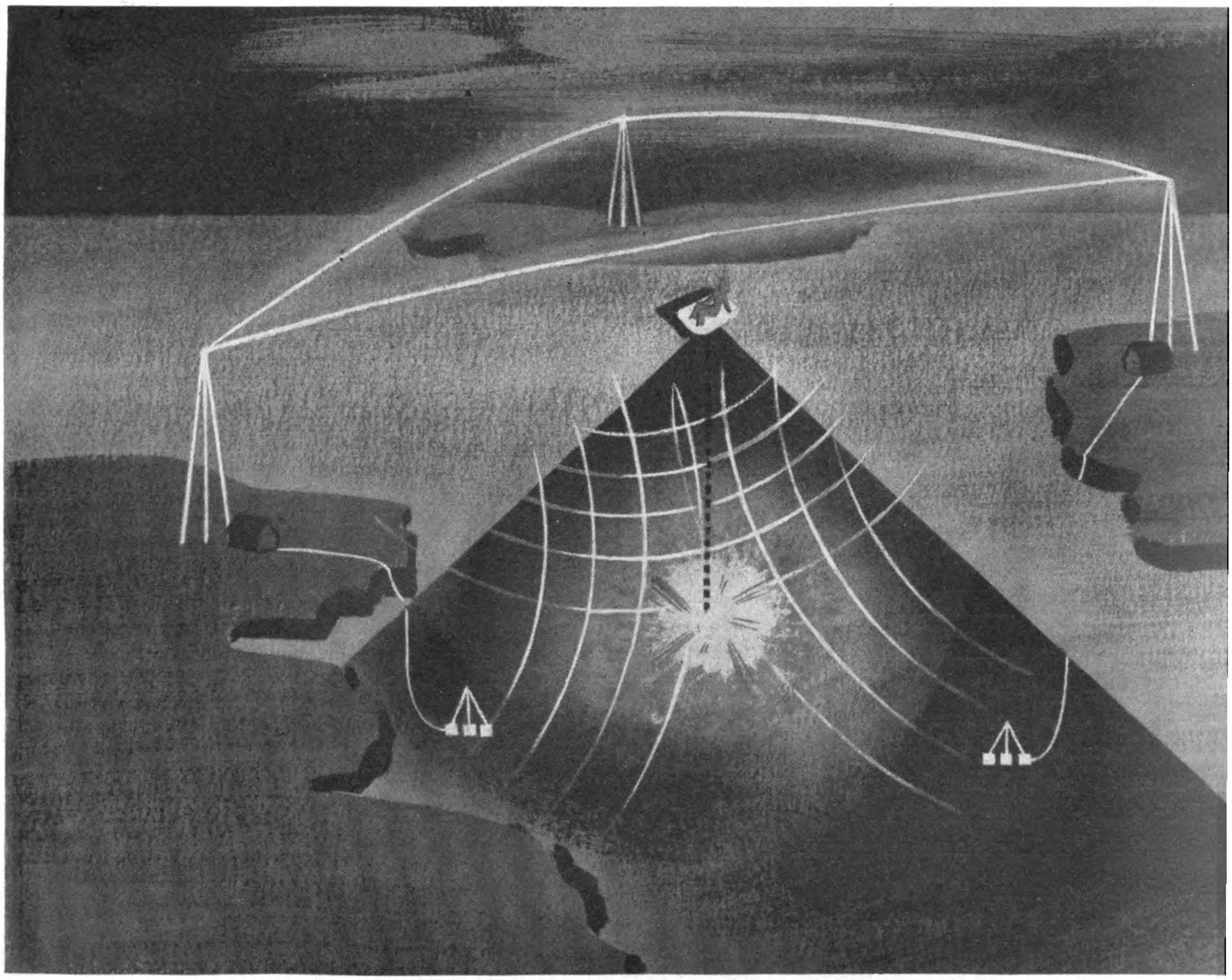
The bending of the path of sound is caused by the changing speed. Sound leaving the explosion by paths making an angle less than 12 degrees with the horizontal is bent so much that it returns into the zone rather than continue to surface or bottom.

Changes in the speed of sound under water result from changes in water temperature and pressure. Increases in both temperature and pressure cause the speed to increase. Hence sound travels faster near the surface where the water is warmest and nea bottom where the pressure is greatest.

Pressure increases uniformly with depth. ' perature increases rapidly as the surface is ne: but is fairly constant at great depths. The s zone is located where the temperature change become gradual. At the center of the zone the s of sound is less than anywhere else in the ocean, 100 feet per second less than at the edges of the s channel.

This explains the curious phenomenon of that tion of the sound which takes the shortest path a ing last. It is traveling so slowly that the sound w swings across its path a number of times arrives

Since the sound zone results from temper changes, scientists are uncertain about its exis in very cold waters where there is little differen temperature between the surface and depths. channel has been explored in tropic and temp areas. Studies near the polar regions will follov



DILBERT DECORATED

:t . . . legendary cartoon character . . .
ɔf what-not-to-do when flying an airplane . . .
) of many of the Navy's famous "Sense"
ɜts, has finally achieved fitting recognition for
ribution to air sea rescue and survival. He
.rded the U. S. Navy Legion of Merit.
ɔting the medal for Dilbert and other cartoon
:rs which he created, was author and illustrator
ι. Robert C. Osborn, USNR. The citation ac-
ying the Legion of Merit reads—"for excep-
meritorious conduct in the performances of
ling services to the Government of the United
; an artist attached to the Training Literature
of Training Division of (DCNO) Air . . .
ɔon characters formed the cornerstone for the
uccessful educational and training program
l Aviation in World War II, and his loyal and
stic labors contributed materially to the effec-
and survival in combat of Naval pilots and
nen."

▼ ▼ ▼

PAPER BLANKETS

Sterner paper blanket was recently tested ιe direction of the Material Division, BuMed, mine its utility and durability under field ıs. Several objectional features were noted strength and heavy deterioration under d tropical storage conditions. However, the ved several excellent features, namely:

. It is fire retardant
. It is durable where there is no contact sture
3. It appears to have satisfactory comfort value against wind and cold when used as extra protection wrapped inside a canvas or wool blanket
4. Logistic features are favorable

The paper blanket may also find use as a protective barrier against the soiling of litters or other blankets, and it is possible that the blanket may serve as a shock sheet indoors.

From a statement by H. J. Symington, President, on the future, plans and problems of the International Air Transport Association,

"Its spirit, as indicated in its formation and in its operations to date, is to act internationally—the good of the individual being bound up in, and cemented to, the good of the whole. In the language of its aims, it is for the benefit of the peoples of the world. It is a pulsating recognition by those operating the instruments which make internationalism not only possible but absolutely necessary, of their particular duty to contribute in the fullest measure to that spirit of internationalism which will bring people closer together and ban forever war, which has almost ruined mankind and which, if it ever breaks out again, will completely destroy civilization. It is upon this note that this association was formed, and it is upon that note that it will continue or fail. Offices will eventually be opened in various parts of the world so that action, where required, can be speedily effected. Matters of clearing houses, traffic connections, facilities, operating techniques, radio control, weather projections, blind landings and the innumerable other questions arising in the fastest changing art in the world, and close approach to governments will fall within the range of its operations. It will eventually grow into a large and, I believe, a most effective organization of worldwide, beneficient influence. It must contribute its part in abolishing bilateral bickerings which arouse national jealousies and recriminations and, ultimately, hostilities."

AIR SEA RESCUE AGENCY

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Adequacy of Air Sea Rescue Facilities

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AIR SEA RESCUE LIAISON OFFICERS

Eastern Sea Frontier

R. L. Burke, *Captain*, USCG
c/o Commander, Eastern Sea Frontier
90 Church St., New York 7, N. Y.

Western Sea Frontier

T. J. Harris, Commander, USCG
c/o Commander, Western Sea Frontier
Federal Bldg., San Francisco, Calif.

Philippine Sea Frontier

W. E. Sinton, *Commander*, USCG
Box 3, Philippine Sea Frontier
F. P. O., San Francisco, Calif.

ComAirPac

D. O. Reed, *Commander*, USCG
Coast Guard Box #1
Navy 48, San Francisco, Calif.

DCGO—17ND

O. D. Weed, *Commander*, USCG
c/o District Coast Guard Officer, 17ND
Ketchikan, Alaska


H/F and MF D/F
NETWORK
NORTH ATLANTIC AREA
U. S. NAVY–COAST GUARD–ARMY–FCC
LEGEND
H/F STATIONS
H/F STATIONS (ARMY)
COMBINED HF/MF DF STATIONS
HF/DF EVALUATION CENTERS
HF/DF EVALUATION CENTERS (ARMY)
NOTE:
Letter "F" After a Symbol Indicates Federal Communications Commission Station
CRYSTAL 2
MARRAK
BE-2
MEEKS
BW-1
BW-3
BE-1
CRYSTAL 1
CAPE HARRISON
GOOSE BAY
MINGAN
STEPHENVILLE
GANDER LAKE
ST. JOHNS
NANDAIGUA
PRESQUE ISLE
JONESPORT
WINTER HARBOR
GRENIER
SEARSPORT
SURFSIDE
NEW YORK
SCITUATE
MITCHEL
AMAGANSETT
REL
CAPE MAY
H, D.C.
LANGLEY
NCE
POYNER HILL
BERMUDA
HUNTER
DUPONT
GLYNCO
TALLAHASSE
MORRISON
JUPITER
MIAMI
S. MIAMI
AZORES
SOUTH CAICOS
TANAMO
SAN JUAN
AM
BORINQUEN
FRANCE
COOLIDGE
TORO POINT
BARBADOS
HATO
VID
WALLER
TRINIDAD
ALBROOK
ATKINSON
ZANDERY
CAYENNE

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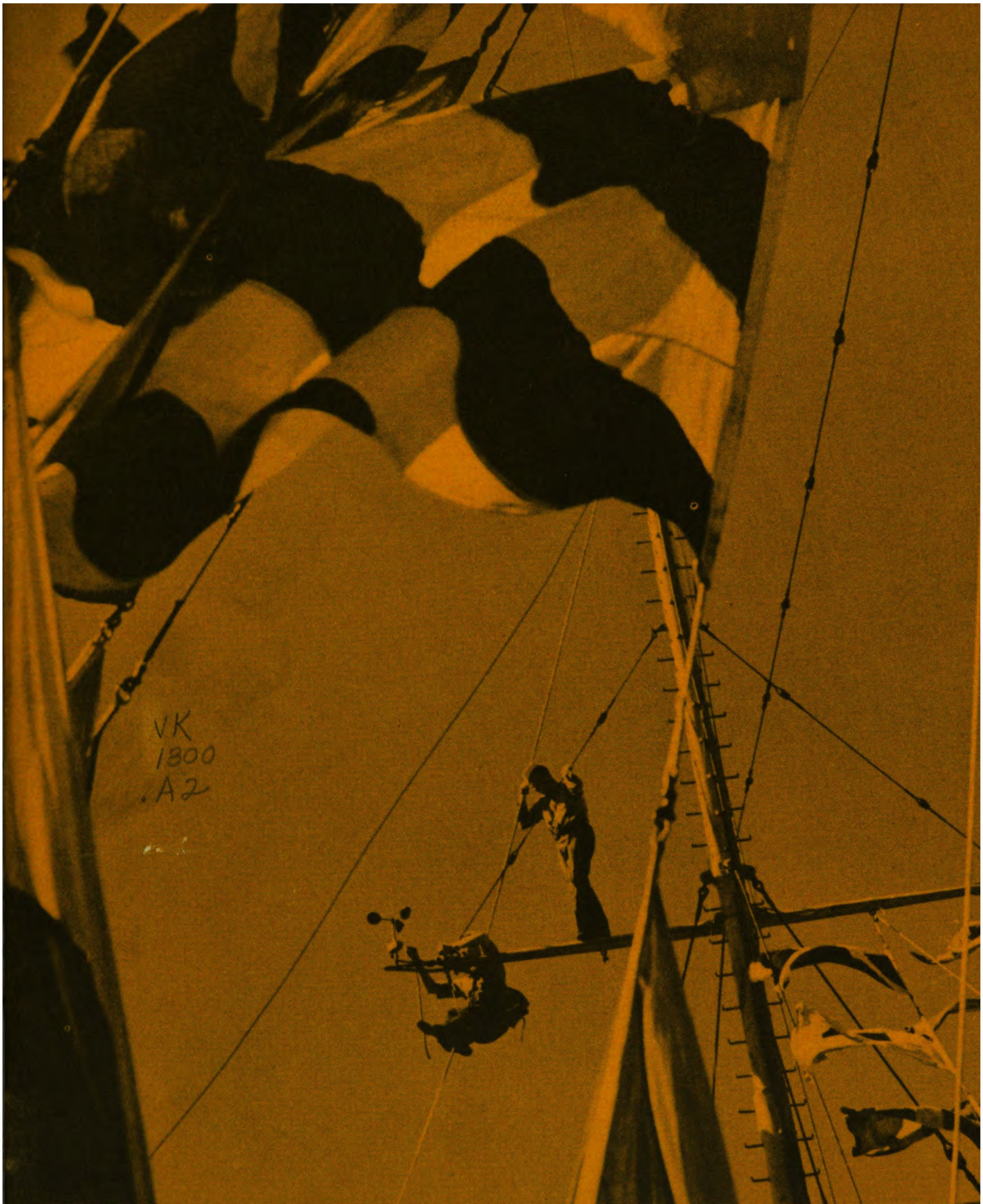


Air Sea Rescue b

NAVCG 128

Air Sea Rescue bulletin

Information contained herein is assembled from various United States and foreign sources; ı disseminated in this BULLETIN for information only to a limited list of addressees with :rest in the field of air-sea rescue and is not for sale. It will be apparent that the BULLETIN r contain information which does not represent the policy of the Air Sea Rescue Agency or Services represented on the Board for Air Sea Rescue.

▶ ▶ ▶ NAVCG 128 VOL. III NO. 5 MAY 1946

'BLISHED MONTHLY BY THE U. S. COAST GUARD FOR AIR SEA :SCUE AGENCY, 1516 14TH STREET NW., WASHINGTON, D. C.

Page

THIS MONTH'S COVER: Atop the foremast of a Coast Guard weather ship, a Coast Guard weatherman and a Boatswain's Mate make adjustments to an anemometer, an instrument used to determine the velocity of the surface winds. This information is then written into the weather reports radioed ... three hours ...ard weather

airmindedness and SAR

FRANK A. TICHENOR

Dynamic Frank A. Tichenor is publisher o, AERO DIGEST and REVISTA AEREA. His per sonal devotion to the aviation industry is legend. He is an honorary member of the Early Birds, and one of the causes close to his heart is recogni tion for the pioneers of aviation in the history of our country. An admirer of the late General Mitchell, Mr. Tichenor is the donor of the "Billy' Mitchell trophy, awarded each year to the Ameri citizen contributing most to aviation progress. Mr. Tichenor is also the donor of the Vargas trophy, awarded annually to the group, squadron company, or similar unit of the Army, Navy, Mar Corps or Coast Guard of the United States, which shall have made, during the preceding calendar year, the most outstanding contribution to furthering good will among the Americas.

Frank A. Tichenor is a member of the Council of The Wings Club, as well as a member of the American Arbitration Association, the Aviation Section of the Commerce and Industry Associati of New York, National Aeronautic Association, and others.—Ed.

In the early fall of 1927 one of our editor a ship returning from London. Whil where off the Grand Banks word was receive that three pioneering airmen, taking off from Beach, Maine, on what they called their "Ol flight, had come down in trouble at sea. As ticular ship was nearest to the radioed po steamed to the rescue.

An explanation of the shift in course was p the bulletin board, and thrilled passengers ately lined the rails with their binoculars. F the vessel had to go some 500 miles to reach and, as the uneventful hours dragged on, the

returned to their whileaway games and other ements. Consequently, when the liner even- did arrive upon the scene, there were but two ree travelers standing on the port side with the ers, straining their eyes at the savagely desolate which now clearly was a graveyard for those oid flyers who, only a short time before, had been ed with life and daring.

the chill of that grim, gray afternoon, most of other passengers were cozily positioned in their , brightly-lighted cabins, dancing, drinking, g fun. The cruel contrast of life and death, their usual concomitant, human indifference, was more sharply presented.

e can moralize on that circumstance, and I re- t for that purpose. It illustrates so pointedly a of mind in which most of our people enjoy the ntages of a bounteous civilization ignorant and ess of the dependence of everyone on everyone

Only a few persons on that circling ship, which thereafter was obliged to give up its search and sume its course, even glimpsed the significance eir narrow inability to avert a tragedy. They practically no sense of responsibility; yet all shared e awful shortcomings of that situation.

doubt that many who were present then have zed in all these intervening years the lesson con- d by their experience, that safety in transportation, ny means and over any distance, depends not on the vehicle and the operator, but on innumer- special circumstances outside. In the air, the eyance is assured of its success not just by depend- structure and competent piloting, but by team- at the surface level where, when all is said and , all flight begins and ends.

at teamwork obviously had not been established Phil Payne, L. Bertaud, and J. D. Hill took off Orchard Beach, but it has moved far toward ection since. Because it has, the advancing con- t of the air is now proving itself in global routes, ning oceans, deserts, Himalayas. Incidentally, use aviation thus now makes its demands on body "to keep it flying," it is just possible that ay become the real occasion for establishing a erhood of man.

is against this broader background, as well as st the technical necessities of a publication office, I view the aviation structure, to which we refer ffhandedly as "airline networks," "certificated tops," and "scheduled feeder-lines." There is more to it. In the "Old Glory" days, almost a full score of years ago, flight was not what it is now, with transatlantic hops so common that they are dismissed by even the man in the street as "a ferry service." The change since is not because the aerodynamics and the power plants were unappreciated at the start, but because the currents, shallows, and peaks of the course were then unmarked and unattended. To be sure, that protection is afforded now. If it were not so, every scheduled transatlantic flight today would be as hazardous as the epochal Lindy hop of May 20, 1927. The "flight of the Lone Eagle" was only about 4 months before the "Old Glory" plane vanished.

The wonder of man-carrying, powered flight as we know it today thus is not in the plane alone, any more than it is in the electronics alone, weather stations or maps alone. It is in all of these things, plus a thousand others, taken together. An enormous number of factors in our so-called civilization have joined forces to make it possible and to sustain it.

Concerning these numerous services that go into making the great fact of aviation let us never, never stop telling the public, because such education builds up that manifestly desirable condition called "air-mindedness." But remember also that it may break it down, for the manner in which the information is imparted may readily defeat the leading purpose.

Take, for instance, those items which are usually pigeonholed as "safety" equipment. To a nervous first-flighter this special stress on "safety" may readily be construed into a panicky suggestion of "danger." I, as an old aviation hand with perhaps too much enthusiasm, refuse to admit that there is any danger whatever in being aboard a plane. So, instead of thinking of any piece of its equipment as a "safety" gadget, I call it a "certitude," an assurance of performance.

I insist that if these three generations—the present generation, the one coming in and the generation going out—are to progress, they must cultivate a constructive habit of thinking. If they are circumscribed by fears about aviation, they cannot become air-minded. Those persons who approach our airports with a feeling of compulsion, because at the moment they can find no other more convenient form of transportation, who climb in dread and with faltering steps into our superb *Constellations* and *Rainbows,* will undo all the improvements that have been made, all the forward strides that have been taken to make American planes and American airways the finest in the world.

To some extent I feel the same way about *search and rescue* (Air Sea Rescue) as a designation of one of the most efficient and one of the least known of those supplementary activities that keep a plane in the air. It is all right to talk about it that way in technical aviation circles where it is understood, but to the first-flighter it is likely to imply "lost and in danger," a difficulty which no modern plane should ever encounter. It is as if the police force of one of our greatest cities should be rated no good unless it battles constantly and desperately with lawlessness, indicating not a firm control of the forces of evil, but a pervading discontent and unhappiness in the population. To my mind, the chief proved function of SAR is to eliminate the risks before they occur—or, better still, to make plane movements so certain that risks will be impossible. That, in fact, is what it really does.

So it seems that I am asking not only that people shall think more completely about aviation—taking more thorough account of its many related factors—but that they shall think in a positive way. I want them to know very fully about SAR; only I ask that, in their developing awareness, they shall not become terrified at the prospect of leaving the ground in the thought that it must be dangerous indeed if all these elaborate precautions are necessary to safeguard it. To my mind that is no useful or direct way to inspire confidence.

The situation constitutes a knotty, ticklish p for the public relations man in aviation. As the numerous safety departments there may w a leaf from the book of nature as it presents a age mother with her babe. The infant is l sleep in the prevading idea that an all-pr mother is there, a fact which is suitably demo a thousand times with croons and caresses.

Now I am not saying that members of th agency should climb aboard each plane and passengers. I am saying, rather, and saying e cally, that the way to inspire public confid aviation is to persuade people that they ar pletely safe in the air, that they may relax their worries, that there are no risks off the which are not encounterable in life's well kno certainties also on the ground, and that an special dangers which may cling to the no flying belong back with the growing-pains of dustry, and are now fully dead and gone with barnstorming days. As to SAR, I should lik the idea presented to the air traveler as a pr which was solidly there *before* he came, ins telling him in effect, "If you crash we'll look and try to fish you out of the drink."

It is not for me to recount the nature and of the magnificent and so modestly conducte service, especially in a place where that is bei constantly and by more competent hands.

ver, appreciate and thank God for SAR. I can m its high purposes and do what I can to aid rformance. I am especially aware that, like thing else useful in a progressive world, it is t to wear and tear and must have its proper ements from time to time, and also—an essen- bservation, indeed—that it must be enabled to along with the rapidly expanding industry of a it is a part. I bespeak for it, therefore, a full rt of all the people.

yone who keeps reasonably up with the news s that the United States is extending its air s into all lands, and that it will need the friendly ration of governments to standardize SAR procedures, telecommunications networks, air-traffic controls and all the other related factors. Citizens who apprehend this urgency can lend force to a solution. We have the wherewithal and the technical know-how and can provide the leadership—and we need global cooperation. No single nation can do it all.

So tell the people about the SAR—and the CAA and the CAB and the IAS and all the rest—and let them, in turn, tell the world. The world must know that the advances we make by all these technological improvements and diversities of aviation are not for the purpose of making life easier, but to enlarge its opportunities for better work. That seems to be the way the Lord wants it.

RMUTIT DESALTING KIT

ne Naval Medical Research Institute, at the re- t of the Bureau of Medicine and Surgery, con- ed tests to determine the effect of storage on the nutit desalting kit. Kits from 13 to 19 months were collected from aircraft carriers, CASU's and groups in the field. The results of tests showed ght increase in the salinity of the potable water uced. There was no relationship between the efficiency of performance and the age within the limits studied. The maximum salinity observed is of no physiologic consequence.

N. M. R. I. recommended that no expiration date be set at this time and that all desalting kits issued to date be considered satisfactory for use. It is contemplated that N. M. R. I. will make checks in the future upon the desalting efficiency of the Permutit kits as they become older.

Short Subjects

NEW SAFETY FOR AMATEURS

Assurance that private pilots who contemplate flying over rugged or sparsely settled terrain will not *stay lost* if forced down is provided in *reporting* arrangements set up by the Civil Aeronautics Administration and approved by the Non-Scheduled Flying Advisory Committee.

Approval of tentative plans for such work by the CAA has been given by the Non-Scheduled Flying Advisory Committee. The plans were drawn by the Office of Federal Airways, and they place the communications facilities of the CAA at the service of any private pilot who chooses to file with any CAA communications station a plan for the flight he proposes to make.

Filing of such a plan is purely voluntary, however, and is not required from any pilot who is making a *contact* or noninstrument flight.

According to the CAA's plan, the estimated time of arrival of the pilot at his ultimate destination is the key item of a flight plan. If the pilot fails to arrive within 2 hours of his estimated arrival time, the CAA communications operator at his point of departure contacts the operator at the point of destination, and a check of the pilot's movements is started. If he does not arrive within 4 hours, an actual search will be started.

This search would involve notification by the CAA to the intermediate stations along the route, the United States Army and Coast Guard, State aviation commissions, the State police, private fliers, and organizations of private fliers, such as clubs, and CAA pilots on duty in the vicinity. In the past many such searches have been conducted at great expense. The Non-Scheduled Flying Advisory Committee proposed that a pilot who flies a flight plan and then fails to complete it by notifying the CAA of his safe arrival be subjected to a fine of $25. This recommendation is under study by the CAA.

The tentative plan also has been submitted to the Aircraft Owners and Pilots Association for their opinions and recommendations.—*Airport News.*

▼ ▼

The Canadian Government, in a quest for shortei passage to Europe, is studying the waters of Hudson Bay, now virtually useless in shipping because of its ice and proximity to the magnetic north pole. With radar to detect the ice and the gyrocompass t(inate the errors experienced with magnetic com the possibility arises of saving about 1,200 miles route from Vancouver on the Pacific coast to pool.

THE COAST GUARD AUXILIAR AND AIR SEA RESCUE

Since the beginning of the war many p citizens along the coast have voluntarily assist armed services in countering enemy action and ing persons in distress at sea. Many of these ha members of the Coast Guard Auxiliary. T ganization was formed primarily to augment i naval forces with experienced men who were to serve in the naval service on a full time basis. men using their own craft, have served without pense and their war effort has been invaluable ir ways.

An example of this contribution to Air Sea is the effective action of several members of Guard Auxiliary Flotillas 1 and 3 of Division 2 Naval District, who saw an Army bomber cras Skidway Island off Savannah, Ga.

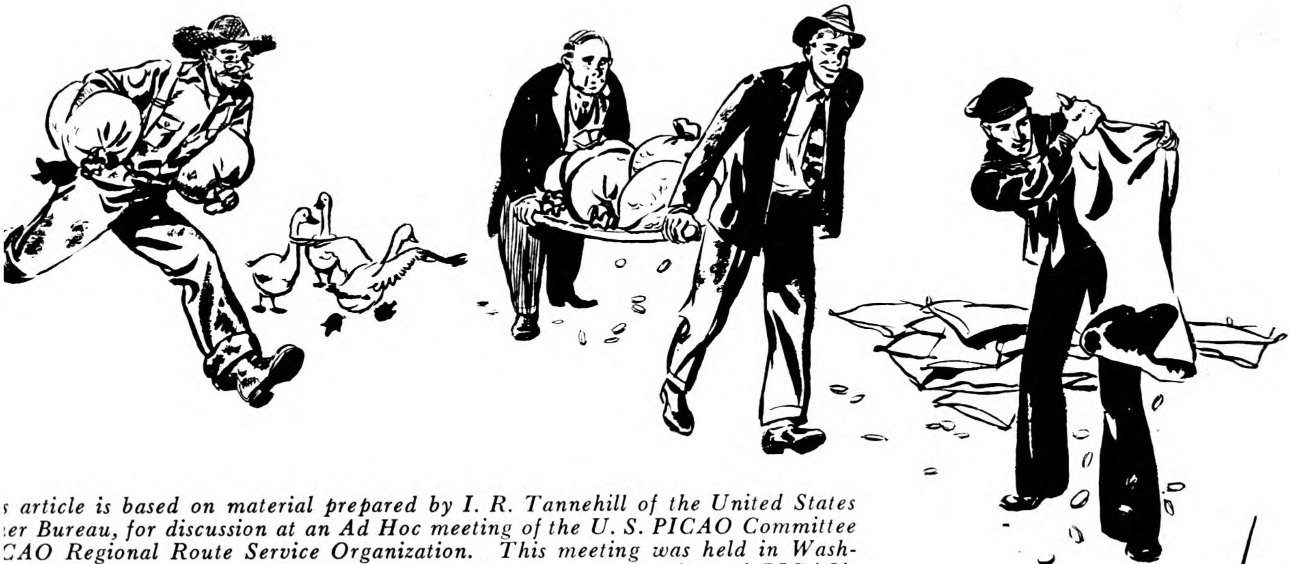
The Auxiliary coast guardsmen promptly arr the scene in several boats, administered first aid survivors, disentangled the badly injured na from the wreckage and took him to the neares where they could obtain medical assistance. the impromptu Air Sea Rescue team returned crash and helped the remaining members of th back to the mainland where Army facilities wer ing to look after them.

Owing to their prompt action and skillful a tion of first aid, these volunteers are credite saving the navigator's life and alleviating the su of the other injured survivors.

ARMY AND NAVY TO CONTIN CARIBBEAN WEATHER FLIGH

Continuation of a wartime agreement under Army and Navy planes undertook weather rec sance in the Caribbean area has been announ the United States Weather Bureau. The agr with the Army and Navy is part of the B hurricane warning system.

During the hurricane season, from June t November, all planes on regularly scheduled will carry special instruments and make rout ports to Weather Bureau offices at Miami, F San Juan, P. R. When there are indications a is brewing, a special plane will be sent into th



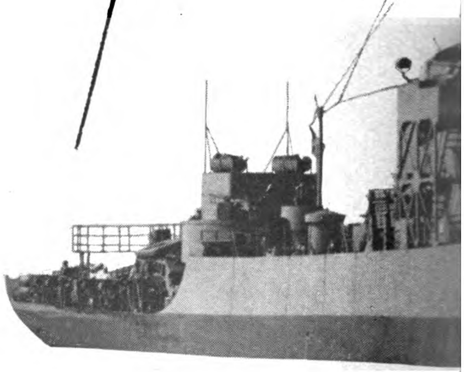
ſ article is based on material prepared by I. R. Tannehill of the United States :er Bureau, for discussion at an Ad Hoc meeting of the U. S. PICAO Committee CAO Regional Route Service Organization. This meeting was held in Wash- , D. C., in February 1946, and was attended by representatives of PICAO's ittees on weather, search and resuce, air traffic control, and telecommunica- ınd representatives of the aviation industry. The bulletin requested permission ›lish it because it is believed to be an excellent treatise on a subject which the careful consideration of thinking people everywhere.

Tannehill is a recognized weather authority. He is chief of the division of ic reports and forecasts of the United States Weather Bureau and, for several was chief of its marine division. He is a member of several commissions of ternational Meteorological Organization, chairman of the meteorological com- for the United States in preparation for the Safety of Life at Sea Conference. the author of a number of publications, including "Hurricanes: Their Nature Iistory" and "Weather Around the World," published by Princeton University —Ed.

all the cost of weather ships be charged to Air Sea Rescue?

little more than 6 years ago we came suddenly upon one of those crises in the weather business which were all too familiar before the vas over. Late in 1939 we saw the dwindling merchant fleets of the shuddering under the increasing destruction of submarine action. gaps appeared in the weather networks over the oceans. Merchant of all maritime nations had been reporting the weather from the criss- ng lanes of ocean commerce. These reports were being entered on veather maps to give us four times a day our picture of ocean weather itions which we needed to keep our transoceanic air commerce operating ety. It was unthinkable that this small ocean air commerce on which ere building our hopes for national defense would have to cease because se increasing gaps in the weather networks over the oceans.

ere were hurried and grave-faced conferences of aviation, weather, air , and shipping groups. There were desperate efforts to get every pos- weather report from merchant ships, but it was clear to everybody that ource of weather would soon cease altogether. There seemed to be no ative but to send ships out to strategic positions on the ocean for the ss purpose of reporting the weather. The United States was neutral, nemy submarines might not respect our neutrality. We might lose that were so desperately needed for other things. The importance of



weather was heavily underscored by the decision to go out and get the weather in spite of the odds against such an enterprise.

Getting weather from the oceans is a job that has never been adequately supported by the governments of the world. We pay nothing to the merchant ship's officer who adds weather reporting to his other duties. It is presumed that he is a high-minded individual who is willing to work for nothing for the benefit of mankind. The point of these remarks is that there was very little in the appropriations for ocean weather that could be diverted to the support of the relatively expensive job of maintaining weather ships. The responsible agencies had to "take it out of their hides," so to speak. The Coast Guard and the Weather Bureau bared their backs and we skinned off enough to start the operation.

It was not easy as it seems in this prosaic recital of the facts. For every ship on ocean station, we need one or two others for relief, for travel between station and port, and for repairs and maintenance. Each has a crew including the weather men who take observations around the clock with upper air so at regular intervals. The operation began in a midwinter early in 1940.

In the North Atlantic where the Gulf Stre ries warm water northward and northeastw tween Bermuda and the coast and fans out i North Atlantic Drift, we have in winter one stormiest scenes in the world. These warm waters yield a tremendous amount of energy atmosphere. The northern part of the area stormiest in the Northern Hemisphere. Furth in late summer and autumn, hurricanes fr West Indies move northwestward and many turn northeastward on a broad curve and sw North Atlantic area with destructive force.

These storms create waves 40 to 60 feet in Ships like our Coast Guard cutters are tiny parison. They seem to be swallowed up by se mad. For as much as 30 days in one con weather watch these ships have clung to a fi sition on the ocean while one great storm a other bore down on them and whipped the a new fury as they passed over. That first early in 1940 was one of the most vicious corded in the North Atlantic.

Nearly every landlubber who goes out v Coast Guard for the first time to take thes weather observations in winter must go th violent period of seasickness. His fellow-c from the Weather Bureau stand extra tours while he is down. Even for the hardene guardman this assignment is no sinecure. job the ship does not run away from the s maneuver around it. The crew fights it slippery decks washed by mountainous w seas. The ship just stays there and takes keeps on sending weather observations and every possible sounding of the upper air on s And throughout the war period there was stant threat of submarines. The time came v had to write letters to the relatives of brave n went down to an unknown grave, victims o or submarine. We shall never know.

At times it seemed to be almost a miracle weather reports kept on coming from this li of Coast Guard ships. They made it pos chart the weather for the vast forces of bomb fighters that flew to the British Isles and po struction on Germany. They gave us wea formation for convoys.

We were impressed by one fact which

cted before this thing was forced on us. Mer-
t ships in time of peace furnish us with free
ıer reports—free except for the cost of radio
ıges which the Government receives at bargain
—but the weather observations of a ship in
it are not useful for longer-term weather fore-
ıg which requires a fairly high degree of precision.
ıs a Nation, need those weather ships. We should
had them years ago.

recent aviation conferences among the nations
e world, there have been resolutions and recom-
lations that the weather ships be made a per-
ınt part of the facilities that are needed to pro-
transoceanic air commerce. They are needed
ɔnly for weather reporting but also for air sea
e, as navigation aids, and
ɛrform other duties of a
ıical nature. The ques-
arises, "How shall we
'y the cost?" We think
ıe importance of air sea
e, but we know that
her is the principal cause
ıe tragedies which make
ɛa rescue necessary. We
of our new aids to navi-
n developed during the
and the importance of
aids in the coming mir-
years of air commerce.
how shall we justify the
in the form of taxes on
farmer and shopkeeper
factory worker? How
we explain why it is nec-
y to apportion this cost,
l though it may be in
days of big appropriations, to John Q. Citizen
may never fly the Atlantic or Pacific? If he
ld fly over the ocean and hear the motors failing
e crackle of the plane structure giving way to the
en onslaught of a storm, he would be thankful for
ittle weather ship with its communications and
ɛa rescue facilities. But that may never happen
m.

is even tougher than that. It must be an inter-
ınal agreement. Other nations eventually must
their share and pass the cost down to the John Q.
ens of other countries desolated and impoverished
ıe war. It is a hard proposition and we must
hard facts. Maybe it will be interesting to probe
a little deeper into the weather problem. We have plenty of justification for weather ships, if we think about it. What does ocean weather mean to us here at home in the United States? Have we really a stake in this world weather problem? The answer is a loud and emphatic, "YES, we have. And How!"

Figure 1 is a dull-looking chart with a lot of small lines. This is a degree-day chart. It tells every John Q. Citizen in the United States how far down into his pocket he will have to dig in the average year for fuel to keep his home warm. During the war it was used as a guide to the number of ration coupons he would get if he heated with oil. Each additional degree-day means more oil, coal, or gas in the furnace or more wood in the fireplace. We think for a moment of what it means if our average temperature goes down just 1°. We can think of all the furnaces and stoves and fireplaces in the United States. At St. Louis, for example, a drop of just 1° in temperature for the year would increase the degree-days from 4,750 to 5,000, or an increase in heating of more than 5 percent.

Keeping warm is a big item. At a rough conservative estimate the cost of keeping the people of the United States warm for 1 year in all kinds of weather is approximately 2 billion dollars. This includes fuel costs in heating homes, apartments, offices, churches, hotels, theaters, auditoriums, warehouses, factories, and on trains and ships, and in every other heated

enclosure. The coal we burn is worth 800 million dollars at the mines, without cost of transportation, middleman's profits, delivery to the furnace, or service charges. The raw fuel (gas, oil, and coal) runs to a billion and a half, but this does not include wood and electricity. Figuring on the basis of St. Louis, the national cost of 1° of temperature below the normal is 100 million dollars. A variation of just 4° up or down—20 percent either way—makes a difference between a very warm and a very cold year.

Of course, the temperature doesn't go up and down for the country as a whole in any such uniform fashion. It gets much colder in some areas than others, but the smoothed result would be about the same. At any rate it is big money and it is just one item in the long

list of justifications for ocean weather ships.

What has this to do with oceans and weather ships? The answer is one we can't dodge. In the wintertime, our continent in the north and the polar regions receive little or no heat from the sun. The air in that great region constantly gives off its heat by radiation. If it were not for the oceans, the temperature would go down and down to depths we have never experienced on our continent. It would be more like Siberia, but even Siberia would be much colder if it were not for the oceans. The oceans hold their heat. They are the great stabilizers of temperatures in the earth's atmosphere. It is bad enough as it is. Our continent in the north gets cold, and cold

waves and blizzards pour down on us from C
but the circulation of the atmosphere and the v
of the oceans come to our rescue. In the lo
the warmer the oceans the less fuel we burn
furnaces and stoves and fireplaces. A little ch
ocean temperature probably makes a big dif
over the continent, but all we can do now is sp
This is just one example of the many phases
national life in which the oceans play a vit
In winter the oceans are to the continents ju
our furnaces are to our homes. But we keep
mometer in the houses and we keep track of c
nace temperatures. We would hardly be
control our comfort in winter if we knew
about our furnaces. Yet we try to maintain c
on our continent v
knowing anything ab
oceans. When we p
look this problem squ
the face, we ought to be
ashamed that we neve
taken the trouble a
thorized the expense
taining accurate infor
about the temperature
oceans and the air o
oceans which so con
surround us in our
sphere.

What have we done
it? The answer is n
comforting. We expe
cers of merchant sh
throw a canvas buck
the side and draw up a
of ocean water and t
temperature, with th
blowing on the thermometer and the canvas.
take the air temperature under similar con
Not very good, we say. Of course not. W
even pay for the canvas bucket or the therm
If the ship's officer is unable to do that, we
temperature of the water that comes to the
engines. The intake may be just below the
of the ocean or far down in the water, depen
the size of the ship and its cargo. This is n
enough for our purposes but there is no other
doing it for nothing.

We ask the weatherman if it will be a cold w
a very important question—but these are the
data we give him to work with. It makes

'Scrooges," but we may as well have the facts. ıat vast and important area between our west and Hawaii where the weather comes at us from 'acific stabilizer, we have no observations that are ı anything for this purpose except the few we rom weather ships at the tail end of the war and ıay close them out before 1947.

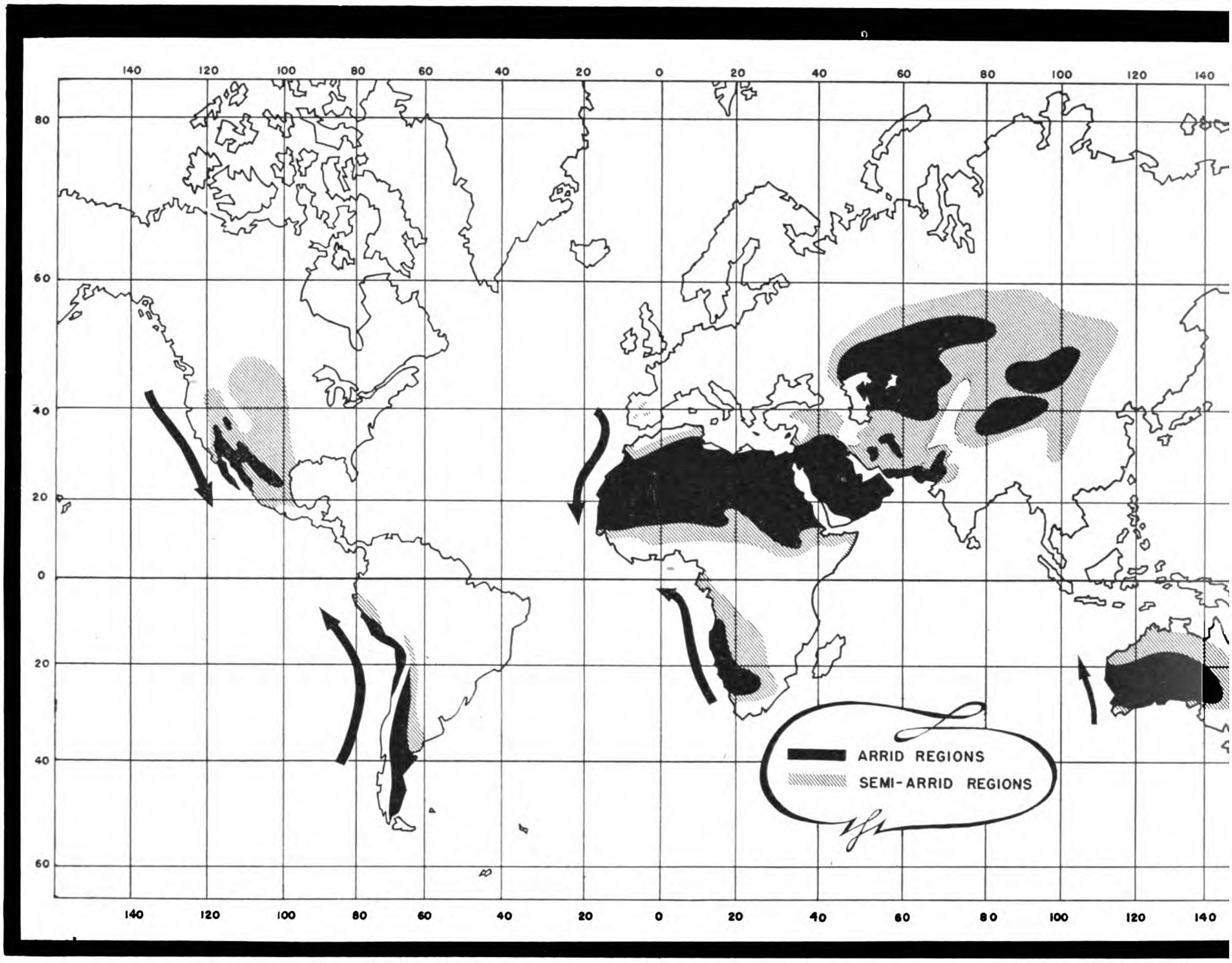
ıere is another example, this time in our far which supplies us with raisins and other dried

The products of this summer-dry climate are h many millions of dollars. The industry is ·d to the normal alternations of winter rain and ner drought. The fruit is dried in the sun. If nexpected rain comes in the autumn before the ıg of the fruit is over and before it can be pro- d, it will be ruined. The Weather Bureau issues warnings so that protective measures can be ed out in time. The causes of rain are found in ondition of the Pacific Ocean. In October 1945 Weather Bureau made a good forecast, as rain :asts go, but it called for a light rain. The ers took a chance and left much of the fruit otected. A moderate rain came—just a little nuch—and the damage amounted to 12 million rs. This is another example of our need for more information from the Pacific Ocean. Everybody knows that it is the relative temperature of the Pacific that controls rainfall in California.

There is a far more important question. Figure 2 shows the deserts and semiarid regions of the world and certain cold ocean currents. On the continents to the eastward of these cold ocean currents there are deserts and surrounding the deserts are regions where irrigation is required for agriculture. We have very little reliable information about the temperature of these ocean currents. There is one along the west coast of South America which is a good example—the *Humboldt Current* or *Current of Peru.* There is a desert along the coast (the black strip in fig. 2). It is dry and barren. Once in a long period of years this cold ocean current of Peru weakens and warmer water comes down from the direction of the Equator. Heavy rains fall on the desert; it becomes a garden; in contrast fish and other wildlife perish in the sea and in the air over the warm water because of the high temperatures; there is a complete change in the climate; there are floods where formerly a barren desert prevailed.

Of course, we have no such event here in the United States! But wait a minute! In the thirties we had

heavy lines connect points having approximately the same average number of degree-days each year. For example, every through which the "5,000" line passes has an average annual degree-day total of about 5,000. The complex pattern in ·rn States is due to the influence of the mountains.—U. S. Weather Bureau Map.



Deserts (black areas), semiarid regions (shaded areas), and cold ocean currents (arrows). All deserts lie in or near tropical pressure belts with cold ocean currents in the nearest ocean area to the westward.

a series of terrible droughts. Our southwestern desert seemed to be expanding. Millions of our people breathed dirt blown from the soil of fertile farms. At intervals dust clouds filled the skies. Several hundred thousand people abandoned their homes in our Great Plains. We had a "dust bowl." In just 1 year of great drought in 1934 the damage to agriculture was estimated at 5 billions of dollars. Less than a decade later parts of this "dust bowl" were ravaged by floods. Wind erosion during the drought took millions of acres of land out of production more or less permanently. Our fertile agricultural land has been reduced to 450 million acres and authorities say that at the present rate, without proper control measures, it will come down 150 million acres. We may then be on the borderline between scarcity and famine when there is another great dip downward in the rainfall curve.

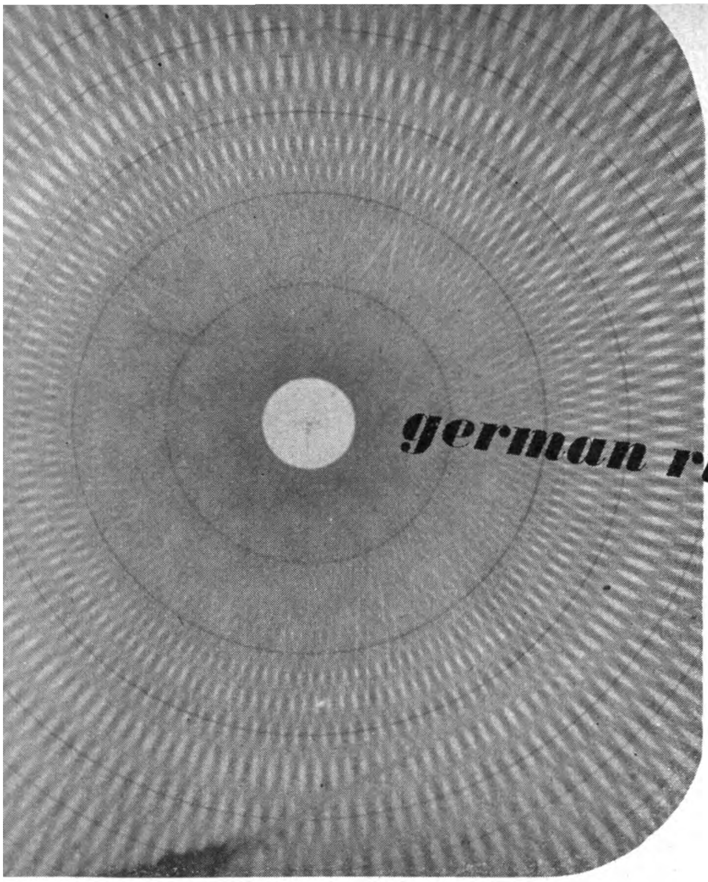
To be sure, weather ships will not prevent dust storms and expansion of the deserts, but advance knowledge of these occurrences would enable us to be prepared. Our national planning could provide for storage of surpluses for lean years and we could have a flexible work and relief program and flood measures that would take care of the extreme rainfall cycles and back up a real program servation of our national resources. Whe events come without warning, as they certainl long as we know so little about the oceans, t weather tragedies of the first order.

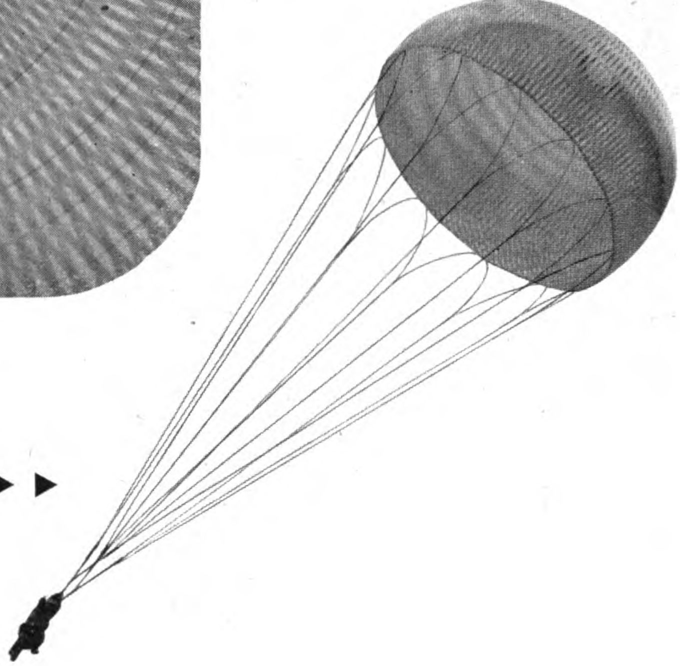
So far as other countries of the world are co the temperature and rainfall problem is eve critical than in the United States. With knowledge of broad scale climatic changes w have international planning in the distrib foodstuffs and adjustment of the inequalities duction of other things that are vital to security.

What causes these climatic changes? W that all of our rainfall comes originally fr oceans. We don't need to be especially b figure that out. And it is not necessary to w other thousand words to show that the cond the oceans is the kernel of the problem and need some accurate observations of the oc

(*Continued on page 48*)

german ribbon chute tested





'llustration showing the ribbon canopy nflated and also the arrangement of the ibbons (2³⁄₁₆ inches wide) which form the ifting surface.

Ihe ribbon chute as designed by German tech- nicians was the subject of tests by Army and ' officials at the Naval Air Station, Jacksonville, a few weeks ago. The tests were under super- ı of the AAF, Personal Equipment Laboratory, ht Field. The primary objective of these tests o measure the effectiveness of a German-designed ın-type chute, as compared to the conventional py chute. Officials at the air base state that this of parachute is only one of a number of possible ions to the destructive forces encountered in ex- ely high-speed parachute inflation. It is still in evelopment stage and requires further refinement, ıse of excessive weight, bulk, and the time re- d for inflation.

Prior to these tests, only three bail-outs in the ribbon-type chute had been made in this country, and the Jacksonville jumps provided the first opportunity for close observation of this type under varying conditions.

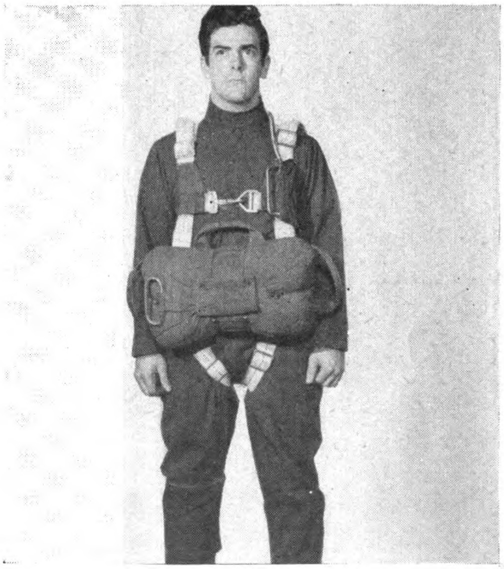
The parachute with ribbon canopy was designed by the Germans for the use of pilots jumping from high-speed planes. With a canopy constructed of 144 2-inch silk ribbons, and a diameter measurement of 32 feet, the new chute offers the advantage of gradual opening and less initial jerk, with the same rate of fall as the conventional one now in use. It was developed by the Germans for use in their jet-propelled ME 262, in which the pilot was flung from the plane by a special ejector seat.

Lt. Col. E. V. Stewart, deputy chief of Personal Equipment Laboratory of the Army Air Forces, Wright Field, was in charge of the parachute jumps which were made into the St. Johns River. Other personnel participating in the jumps were Comdr. J. R. Smith, NAS, Jacksonville, and Master Sgt. M. Kanowski, ATSC, Wright Field.

The live jumps at Jacksonville were a continuation of live jump testing over Lake Erie started in August 1945. Bailing out conditions were: 5,000 feet altitude at an indicated air speed of 150 miles per hour from the door of a C–47 aircraft. The first jump, made by Lieutenant Colonel Stewart, featured a delayed fall of 1,000 feet before the rip cord was pulled. In the next two jumps by Commander Smith and Master Sergeant Kanowski, the rip cord was pulled immediately. Opening time for the parachutes was the same, 3.2 seconds. As noted in the Lake Erie jumps, the opening shock, as experienced with the standard parachute, was absent. During descent there oscillation noticeable to the jumpers. Rate of was equivalent to that obtained with a stanc foot diameter emergency chute. These thre completed six live tests made under the aus the Personal Equipment Laboratory, Wright

Officials making the test state that the pres of parachute research is to develop various types of chutes to meet specific special needs, a the old idea of one parachute design to me use is no longer sound.

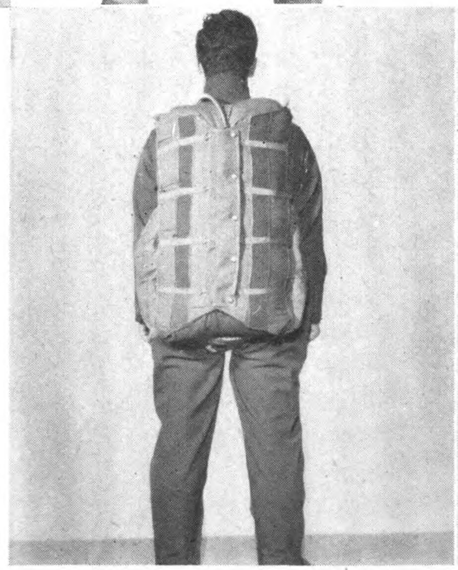
As the planes of the future will have ratec of 500, 600, and 700 miles per hour, mayl faster, both the Army and Navy are intere developing equipment that will meet the need and important knowledge which may mean ir safety for future airmen who are forced to silk from fast jet and rocket-propelled ships future, result from such tests as these at Jacks



▲ *Lt. Col. E. V. Stewart wea ribbon chute, seat pack, a release harness. Lieutena nel Stewart's test jump in t was his four hundred ar seventh parachute drop.*

▲ *Front view of German ribbon canopy in back type pack.*

Back view of German ribbon canopy in back type pack. ▶



▼ *Side view of German ribbo in back type pack.*

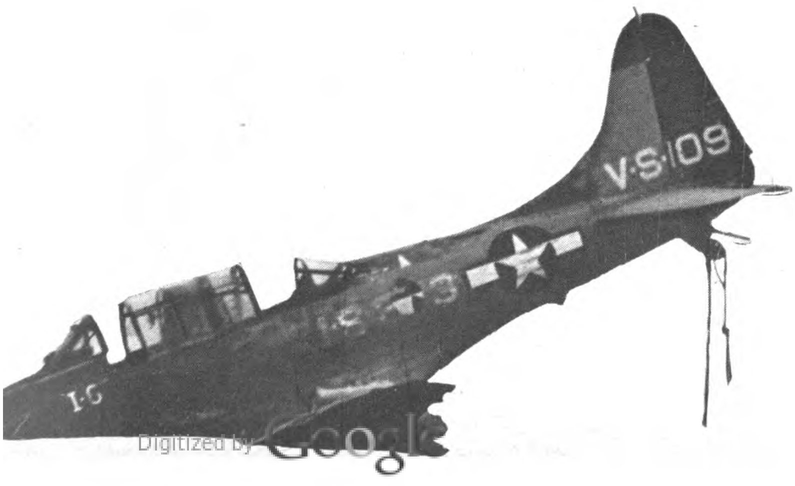
ıe following article is not intended as a brief ɔr against the helicopter. It is believed the opter possesses great potentials of service to ·h and rescue. It is believed, too, that many ic misconceptions exist concerning its advan- ; and disadvantages. The object of this article, ·fore, is to present the opinion of competent and military authority concerning its develop- : and future use; to cite the search and rescue rience of the military services with it; and to ·nt a brief exposition of the future plans of military services as they relate to its use in ·h and rescue. Grateful acknowledgment is ɐ to the publishers of Aero Digest, to the Army ᶠorces, and to the Navy and Coast Guard for iding the basic material for this discussion. Ed.

Helicopter designers and manufacturers generally agree that a release from the pressure of military requirements will permit concentration on the many problems yet to be solved, and bring closer to realization the standards of operation and usefulness which experience has proved to be desirable.

In spite of the fact that if you put a helicopter advocate and an unreconstructed fixed-wing supporter together, the ensuing argument will charge the atmosphere—it's that biased on both sides—most authorities think there will be little competition between the respective types of aircraft; rather they will supplement and help each other. One view is that the helicopter will hold to short-haul jobs, while the airplane will carry the load in trips over 200 miles.

Nor do these competent authorities subscribe to the "helicopter in every garage" school of thought—at least, not yet. They believe that for some time to

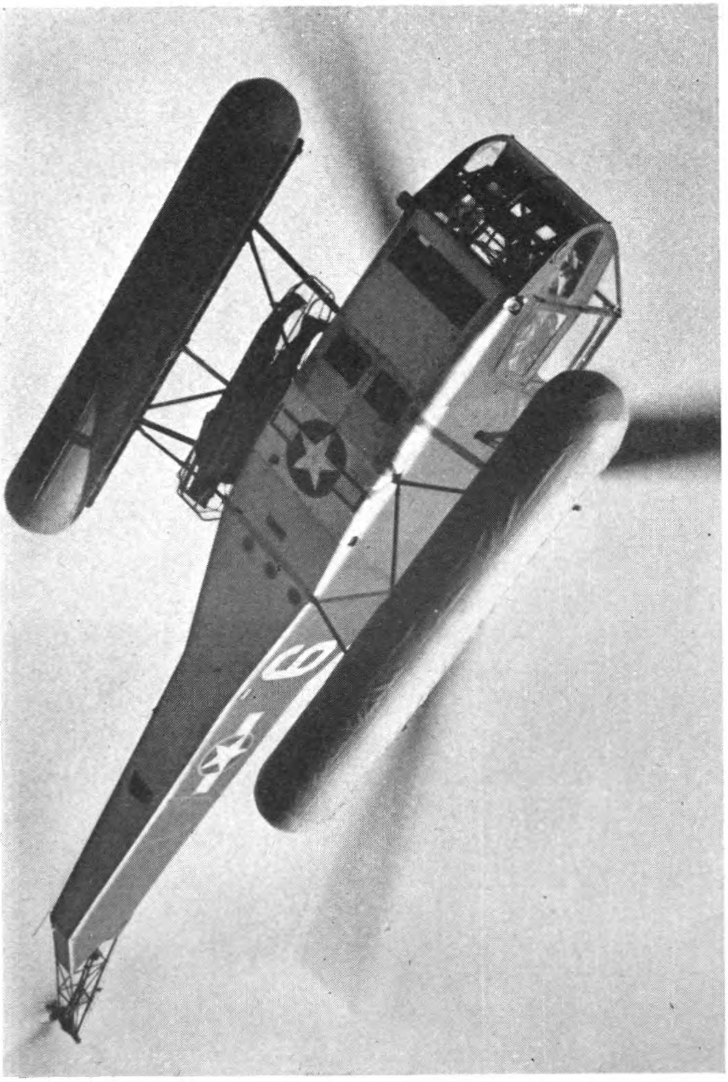
elicopters



come, the relative cost of helicopters for individual use will be considerable, and that their maintenance will require more than the facilities of the neighborhood garage. Nor will the man in the street be able to take over the controls of the helicopter for a while because of the delicate coordination still required for its operation.

The helicopter, however, is no longer an inventor's dream. Some surprising and hitherto secret figures are now available concerning its commercial and military uses during the war, all of which offer considerable promise for early adaptation to many fields of commerce.

More than 400 Sikorsky helicopters, for instance, were built on military contract for the AAF, Navy, Coast Guard, Royal Navy and RAF—logging more than 30,000 flight hours. They performed splendid service in Burma, in Labrador and other parts of the world. Their future in many fields of industry—as



well as in search and rescue and other militar
is well on the way to becoming a practical re

For the oil industry, there will come aerial
of pipe-line routes, and pipe-line inspecti
maintenance. For agriculture, will come pe
trol. Insecticide released under the helicopt
disk is driven downward among the foliage v
agitated so that the underside of leaves, as wel
stems and stalks, can be reached by the ch
This puts it where the bugs are apt to hide.
Forest Service, more efficient aid in spotting

Timber estimation, animal censuses on ranc
ranges, and the guiding of fishermen to schools
and mackerel—these are but a few of the heli
commercial possibilities.

It is interesting to note, too, that a helicop
been used to study volcanoes in Mexico. Mo
75 flights were made to permit observers to lo
the newly-formed Paracutin volcano at close
thus confirming previously propounded theo
the action and formation inside the volcano.

It has been proposed to establish a helicopt
service to 49 post offices in the vast Los Angel
and originators of the proposal expect to be
operating this service within the year.

Some helicopter manufacturers have expre
opinion that an attempt to convert existing
types into commercial models would not be
enough to justify the effort. They feel the co
job would necessitate a major redesigning
which, in the long run, would be far less ac
than a helicopter built especially for commer

The primary consideration in the commerc
signed helicopter must be low operating cos
will be possible of achievement only when he
engineers are able to obtain a maximum of p
ance from a minimum of horsepower. It
doubtful that the helicopter, for awhile at le
be able to match the ratio between horsepow
performance which the fixed-wing type of
possesses.

Perhaps some type of artificial cooling wh
permit continuous operation of the power pl
high rate of revolutions per minute, will provi
of the answer to the problem of more econon
eration. Another factor which contributes
maintenance costs is the helicopter's compa
complicated and delicate transmission system.

Rotor blades pose another manufacturing p

◀*Underside of Heliocopter, showing floats for water*

present they are costly, and interchangeable only ts because they are built by hand. Some method t be found for achieving uniformity in production sure constant, controlled performance. It is possible that all-metal blades may provide the answer.

Much discussion has been heard about the simplification of instruments and controls. But for the immediate future, simplification may not be necessary use the new helicopter pilots will probably be with fixed-wing experience to whom the fairly plicated control plane will provide no mystery. less mechanically-minded pilot may have diffi- orienting himself in the present helicopter "of-" Simplification will come with improvements esign. There is no reason why the helicopter's

Heliocopter rescue by means of wire cable and winch

rol panel should be any more complicated than of the average light plane, except for the one or special instruments required for the operation of ry-wing aircraft.

he same applies to flight controls. While no rea-ble person expects push-button piloting in the iediate future, if at all, unnecessary and unrelated rols should be eliminated as, for instance, coordi-on of the throttle and collective pitch control into iall, handy lever similar to the throttle on con-ional aircraft.

here are currently about 70 manufacturers work-on helicopter design, some of them in the blue-t stage, some flying experimental models, and in limited production. Considering the engineering and manufacturing skill available to these companies, it is safe to assume that their ultimate goal—dependable performance at low operating cost—will be achieved without undue delay.

It is generally agreed that the experience of the military services with helicopters provides an invaluable fund of information to assist helicopter engineers in their efforts to achieve the standards of operation required to meet future commercial and military needs.

The Army's helicopter experience dates back to the inception of air warfare in the original China-Burma-India theater where an increasing number of Allied air crews were being downed in terrain where ground movement was virtually impossible. At the beginning of the aerial war with Japan in this area, the major emphasis was on Burma. The Burmese jungle made rescue incredibly difficult. Thus it became imperative that an effective rescue plan be instituted to bolster the morale of the air crews operating there. L–1B's and L–5's were brought in. They were the only available aircraft which could even be considered for use in the jungle. When small clearings could be found, they were moderately successful. However, in most cases a walk-out was required to reach the landing spot and this caused the death of many men who, despite intensive training efforts, were unable to survive in the terrible jungle.

Eventually a detachment of four R–4 helicopters were brought to Burma for rescue and evacuation

work. Many rescues were effected by these little ships, from sea level to 4,700 foot altitudes in packed jungle areas. The R–4's, however, were obviously underpowered, could carry but one passenger, and had an extremely limited range. Their lack of reserve power was the cause of several narrow escapes, and resulted in the failure of several missions. Besides, their maintenance was a difficult problem, due partially to a lack of spare parts and qualified maintenance personnel.

With the development of the R–5 and R–6, more powerful helicopters became available, and five YR–6A's were sent out to China as a part of land rescue organization. They were accompanied by four helicopter mechanics and a trained Sikorsky trouble-shooter. (By this time—Burma having been freed—the air emphasis had shifted to the Hump and China.) The R–6 was modified slightly and carefully crated inside the C–47's which flew them to China. Seven thousand pounds of spare parts insured an adequate supply for at least the first 6 months of operation.

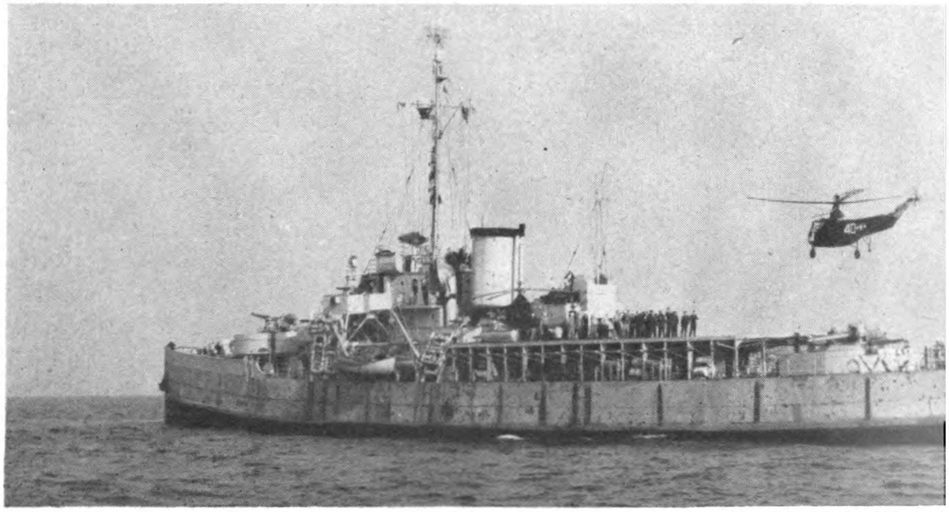
When these ships arrived in China, it was found that the base for initial operation was 6,250 feet above sea level. No helicopter had ever been flown from a base that high. One helicopter was completely assembled within 20 hours after it was taken out of the C–47, and successfully flown for 15 minutes, carrying two men and a 2½-hour load of gas.

Within a week, four more helicopters—two of which had been ferried over the Hump in C–47's and two in C–54's—were assembled and flown successfully. During this period exhaustive observations were made to determine their operational capabilities. Vertical take-offs (zero run) were made from altitudes as high as 7,200 feet, and they were flown to altitudes of 13,500 feet with comparative ease. Th then flown for 5 hours with a reserve of hour's gasoline, which is claimed to be an u world's record. They were able to hover as 20 feet off the ground at 6,500 feet above s With two men, a full load of gas, and with nomical pitch setting, they achieved a spee miles per hour at 7,000 feet. They consumed lons of gas per hour which gave them a r approximately 400 miles. This range was in to 600 miles with pilot; or, by a combination fuel tanks and increased seating capacity, wi passengers in addition to the pilot.

One of the first helicopter rescues in Ch May 1945—dramatically emphasized its Three Americans were found in a valley of the completely isolated from American bases. the advent of helicopters in this theater, the c to get them out would have been by means of out which presupposed good physical conditi required 2 to 3 weeks.

Three helicopters were flown in from the staging area. They made the pick-up and r the men to safety in *1 hour and 20 minutes.* not for headwinds, the time required would ha even less. Terrific downdrafts were enco when flying close to the faces of cliffs, wh necessary to successful maneuvering in the val was found that the helicopter performed bet fixed-wing aircraft when turbulent air was e ered. It was concluded that the R–6 helicopt operate in any thermals, at any distance f ground; obviously the closer the helicopter app the ground in a strong downwind thermal, th effective the ground cushion becomes until, a

Coast Guard Cutter standing by for landing Heliocopter



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t, hovering can be maintained as easily as in r or horizontal wind. Except for the discom- ıermals (strong vertical currents of air) did not ɛr helicopter operations.

m the experiences of the Burma-China area, it ɔncluded that the modified R–6 would accom- e two persons and 100 gallons of gas; or four ıs and 50 gallons of gas. Further, equipped with a winch, it could furnish efficient rescue coverage within a 300-mile radius of its operating base, in any area of the globe except, possibly, in portions of the Andes or Tibetan plateau. For water pick-ups the winch is essential and, even with a load capability of three passengers, four helicopters would be necessary to rescue one heavy-bomber crew.

In the opinion of the Army Air Forces, maintenance requirements were an irritating deterrent to effective field operations. On controversial questions, there were usually two widely varying viewpoints: One was summed up in the phrase "helicopters require 20 hours of maintenance for every hour of flying" . . . the other said "helicopters are as easily maintained as light planes in a comparative weight class." But, as usual, it could be assumed that the helicopter's maintenance factors fell about halfway between the two points of view. On horsepower rating, it was the prevailing opinion that the helicopter did require greater maintenance than any other aircraft using a reciprocal engine. However, given two good rotary-wing mechanics per ship, and 100 percent spares on movable parts, it was generally agreed that maintenance costs would not be prohibitive. From the standpoint that the helicopter has filled a particular need which no other type of aircraft could fill, it is believed that the maintenance expedients developed as the result of operational experience were fully justified. The most effective of these expedients was to take a worn or faulty part completely off the ship—an entire assembly at times—installing a new one, and working on the old one while the ship was in use. Thus, the ship could be kept in the air for a greater percentage of the time. Perhaps the most hopeful view of the question of maintenance is that, rather than having achieved the ultimate in transmissions, power plants, and other operating parts, we are only on the threshold of design and engineering possibilities along those lines.

The Army Air Forces are now utilizing R–5 and R–6 helicopters for land and sea rescue units, both in the Continental United States and in overseas theaters. At present, their utilization is limited because available types are handicapped by their short range and inability to fly in all types of weather. However, it is contemplated that future models will have the extended range, load capacity, and all-weather capabilities which are desired. At that time it is expected helicopters will become an important search aircraft, and will take over the preponderance of the Army Air Forces air-sea and air-ground rescue.

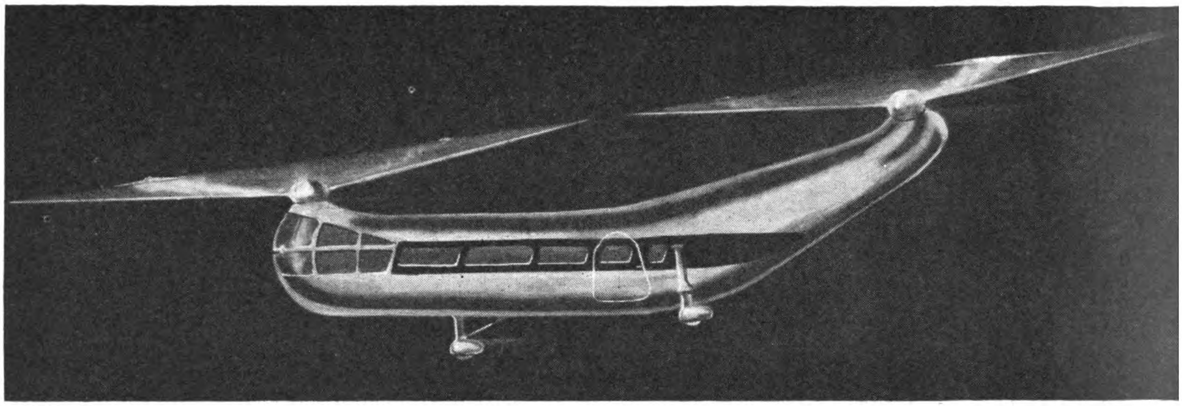
The Navy felt that the helicopter's state of development during the war, and the prospect of producing a useful service model before war's end, did not warrant the diversion of engineering effort, manpower, and facilities to this end. Thus, until recently, the only development projects undertaken were two experimental ones concerned with producing a large helicopter which would serve to meet the rescue requirements of the Coast Guard.

Since the end of the war, the Navy has initiated procurement of three additional helicopter models. Two of these are the result of a recent design competition for a small three- or four-place craft with special emphasis on high performance and other characteristics believed necessary and desirable for successful operation from all classes of carriers. It is not improbable that, after a practical helicopter has been developed for naval use, the present types of aircraft carried on battleships and cruisers can be replaced by the versatile helicopter, thus eliminating the need for catapults, aircraft cranes, and other cumbersome items of handling and recovery gear. In addition, many other naval uses for the helicopter suggest themselves. They may be used for ship-to-ship and ship-to-shore liaison work in transporting personnel, mail, and small items of freight. Hundreds of times, during the war, destroyers were maneuvered alongside vessels of a task force at sea to deliver essential mail, photographs, or personnel—and the superb seamanship frequently displayed in this operation was a source of admiration—yet the basic inefficiency of this type of maneuver, and the hazard to vessels and personnel suggest that helicopters, equipped with hoists, could do this work in much less time, with less danger, and without diverting the vessels of the task force from their courses or positions. The same factors could plied to the transportation of personnel, ma freight at fleet anchorages, at beachheads, amphibious operations, where boating is ofte difficult, and uncertain.

Helicopters may also be used to practical ad for traffic control work in crowded anchorag as control craft for directing amphibious ope This is especially true if they are equipped wit and with loudspeaker equipment such as was successfully tested for use on aircraft. Utilit which require an aircraft capable of hoverin and of flight speeds below that of conventio craft—such duties as that of observing torpe boat speed tests, radar calibration, and the r of target drones—suggest other fields of spe fulness. That the need for helicopters exists dent from the numerous requests from Na activities for an aircraft capable of performi specialized utility services. However, devel has not yet progressed far enough to warrant procurement.

The most obvious use of helicopters by s forces has been in the field of air sea rescue, mercy and other transportation missions to l inaccessible by other means. The Coast Gu charged with the responsibility, during the developing helicopters for naval use. Its res shipboard experience with them led to the d ment of specialized equipment and technique augur well for the future. In fact, it was on t of this experience that the Navy placed a he aboard the carrier Midway on its arctic test exp

THINGS TO COME



Telephone Reporting System

THE EVENT OF PLANE CRASH . . . plane in e . . . parachute seen . . . persons needing help in ıter . . . boats on fire or otherwise in trouble . . . or, v case where the Army, Navy, and Coast Guard can . . . first—do the best you can, then—pick up the one and say to the operator, "AIR SEA RESCUE."

HESE are the opening lines printed on ASR instruction posters that, since April 1945, have ne familiar sights in fire and police stations the Atlantic coast. These cards are a part of 'elephone Distress Warning System developed by New York Telephone Co. and Coast Guard ›rities.

ıring the war the telephone was part of the great nunications system that was the nerve center of ır activity; one that of necessity had to act without city in order to accomplish its purpose.

ıe present system is an outgrowth of the long-lished Marine Warning System by which ships ›ped with radio telephone can not only receive ıges, but can talk directly with radio telephone ns located at Boston, Wilmington, Charleston, York, and Miami.

ring the time of intense enemy action along the ıtic coast, representatives of the Eastern Sea ier contacted the telephone company asking for ›ration in handling messages emanating from g vessels that had been equipped with radio to t submarine sightings, suspicious aircraft and s, or aircraft in distress. Trained operators were d at the radio telephone stations and the coded ges received from the fishing vessels received a ›riority routing directly to the Army and Navy :tion.

When it became apparent that another phase of distress reporting, land wire (ordinary telephone service) was necessary, a new problem arose. Negotiations between the Navy and the First Air Force culminated in the agreement that all reports of either surface vessels or aircraft in distress, offshore or inland for an area of 15 miles as a minimum, would be handled by the centralized air sea rescue reporting system. They, in turn, would alert the Army and would initiate activities immediately.

Herbert J. Schroll, assistant vice president of the New York Telephone Co., acted as liaison for the Bell Telephone Co., with the armed services. In discussing the problem two things were determined to be necessary: (1) What type of call should it be, in order to indicate its emergent nature; (2) a system to assure that the call would be handled automatically-collect-to the air sea rescue center with the minimum of delay in obtaining its acceptance.

The complete plans for the Telephone Distress Warning System evolved rapidly and were put in effect in the New York area on a trial basis. So effectively did it operate that it has been extended along the entire Atlantic coast.

Since the air sea rescue unit was acting upon all reports, the phrase *Air Sea Rescue* was chosen as the signal for distress calls. The telephone company trained their own controllers and assisted in training the air sea rescue controllers by means of lectures and use of the mirrorphone.

Realizing that a single distress might be witnessed by many persons, operators were trained to screen calls and route the information correctly and rapidly in order to expedite rescue. The essential features of the system are as follows:

(*a*) The commander, Eastern and Gulf Sea Frontiers assumes the responsibility for handling the dissemination to proper rescue agencies, of all information of distress submitted by the public occurring within a coastal zone about 15 miles inshore from the Atlantic and Gulf coastline.

◀ *A fisherman tending his nets on shore sights an airplane crash.*

Report of the crash comes in on the local police department switchboard. ▶

(*b*) Civilian witnesses in this zone are encouraged by posters, or such other means as air sea rescue officers may devise, to report plane crashes, ships in difficulty, and other marine accidents involving danger to life and property directly to local police and fire departments, or local Coast Guard stations. Such distress reports received by telephone operators are routed to local police stations.

(*c*) Arrangements are made so that local or State police and fire departments serving the community will take such emergency action as is possible, and will immediately report full information of the distress to the nearest selected *Air Sea Rescue Operation Center.* To facilitate making these reports, the local telephone companies set up a system whereby the person telephoning distress information will precede the Air Sea Rescue Operation Center telephone number by the words "Air Sea Rescue." The use of these words will insure expeditious handling of distress calls by telephone operators and the automatic assumption of toll charges by the Air Sea Rescue Operation Center.

(d) The system is known as the "Air Sea Rescue Telephone Reporting System." In setting up the system, necessary toll terminal trunks from the nearest telephone exchange, to turrets in the Air Sea Rescue Operation Center were provided. ASR Task Group Operation Centers received these reports from surrounding areas, but in the event that considerable activity warranted similar installations at remote ASR Task Unit Operation Centers, the system was set up at those places.

In addition to these, maps were prepared showing each town, city, and borough within 15 miles of the coast whose police and fire departments had agreed to contribute to the success of the system. These maps show the area of responsibility of each operation center which receives these calls, and maps were made available to the local telephone companies so that the operators in the exchange affected could be instructed in the proper forwarding of air sea rescue calls.

Posters were provided and disseminated to the agencies in question within this coastal zone, and various other means were used to indoctrinate the public.

An air-sea distress call means that every second counts in putting up a telephone connection. It may save lives. In such cases an operator's quick thinking and prompt action makes possible the rapid mobilization of the fastest and most efficient search and r The operator's service is not finished when th distress call is correctly routed; she is trained tc by and expedite any subsequent calls that may b essary. An excellent example is the case of a phone message saying that the son of the capt a fishing schooner had been critically injured i fall down a hatchway. The operator imme called the nearest ASR Control Center. Still ing by, she put through a call for the control for a weather report; contacted the captain fo scription of his boat, and then relayed a syst signals for the schooner's use that it might be easily identified from the air. A PBY, with a aboard, made the rescue trip and the boy was c transferred to a hospital ashore.

The Bell Telephone Co. deserves a note o mendation for the part it has played in imp search and rescue communications, and for its ance in establishing the ASR Telephone Rep System. An appraisal of the effective coopera the telephone company is contained in a lette Vice Adm. Herbert F. Leary, USN, forme mander, Eastern and Gulf Sea Frontiers. It in part, as follows:

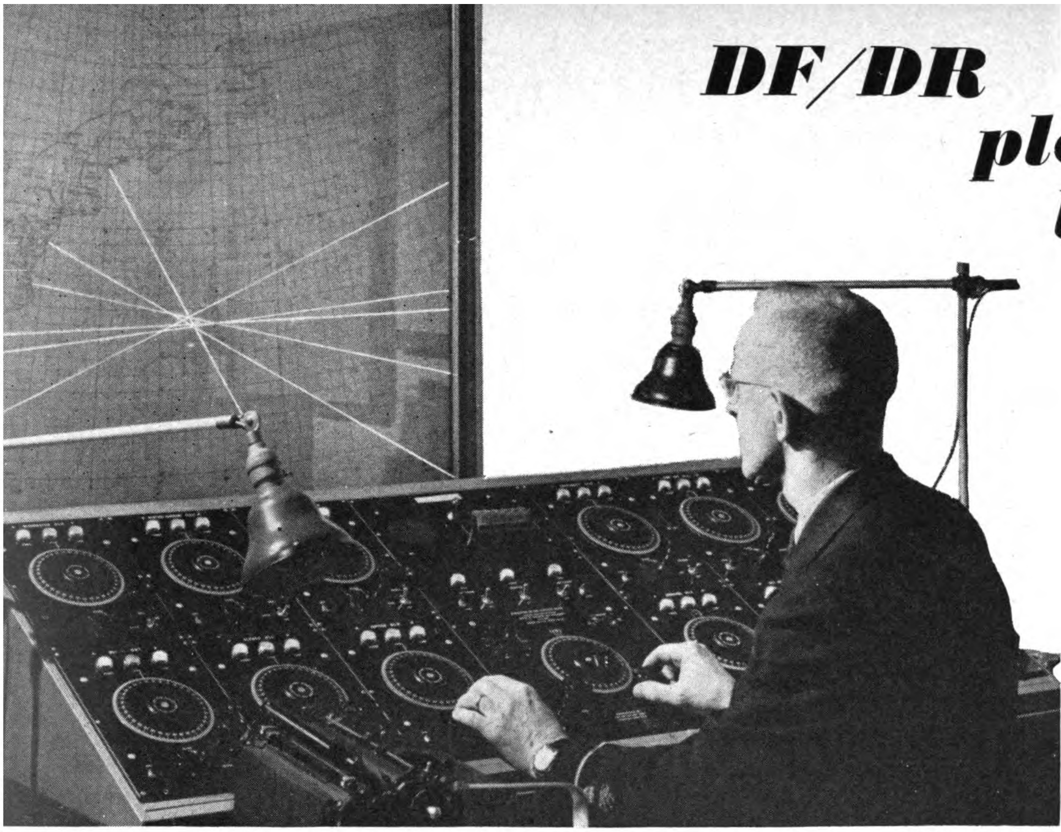
"The interest exhibited by your organizat the many cases where Telephone Co. controlle ities have picked up distress messages and forw them to Air Sea Rescue Control Centers is a ated. The telephone distress warning system in by you working with our Air Sea Rescue Organ is in daily use speeding the handling of distres ters. The frequent use of the Telephone Co 'Marine Operator' to transmit distress calls an prompt delivery to Air Sea Rescue Controlle been of tremendous help.

"As you are aware, adequate telephone fa form an important part of the Air Sea Rescue s Your assistance in helping us obtain and in these facilities has been invaluable."

The alert is passed to an Air Sea Rescue base. A Coast Guard PBM takes off on its rescue mission.

Arriving at the scene of the crash, the PBM picks up the survivors and flies them back to the base.

DF/DR plotting board



R Plotting Board in operation. Each large dial represents one DF station on the chart. enter dial projects a rotatable grid on the chart, enabling the operator to determine course istance between any two points.

SCIENTIFIC device which aids materially in cutting the time required to obtain an accurate the scene of a search and rescue emergency is F/DR Plotting Board in operation at the East- ea Frontier Rescue Control Center in New York. ned and developed under supervision of the Spe- Devices Division, Office of Research and Inven- United States Navy, the board is designed to be at a Radio DF Plotting Center for plotting clas- DF radio bearings semiautomatically, and arriv- t a fix rapidly and accurately. The face of the may be used to record DF fixes, and to keep a d of running DR plots.

e unit comprises a central control desk and the ng board. The plotting board consists of a ucent gnomonic chart, 4 by 4 feet, mounted on d transparent backing in a vertical plane. At a ice of approximately 12½ feet directly in back e screen, or chart, a group of projectors is ted (one for each DF station on the chart— num of 12 bearing projectors on this model). DF station projector is capable of projecting of light ⅛ inch wide and 4 feet long on the , the end of which will rotate about the DF sta- in question. The color of the projected line ponding to the classification of the bearing— , green, or red—along with the on-off switch and bearing, is operated from the central control desk. An additional projector, which projects a rotatable grid on the chart, enables the operator to determine course and distance between any two points on the chart. A six-station intercommunication system is included, with a device to aid in quickly relaying information to and from the central control desk.

Because of the accuracy and ease by which bearings can be plotted and evaluated, it is believed the use of this device not only results in saving considerable time in arriving at a DF fix, but effects a corresponding saving in manpower as well.

The over-all size of the chart cabinet is 4 feet 6 inches wide, 6 feet 8 inches high, and 13 feet long. The control desk is approximately 6 feet wide, 3 feet high, and 2 feet 6 inches deep. The distance between the chart cabinet and the control desk can be varied, depending only on the length of connecting electrical cables. The power required is 110 volts—60-cycle, with a maximum of 25 amperes current.

Device 1–CJ, as this plotting board is called, was designed and constructed before the full use of the direction finder networks was achieved for rescue purposes, and before these networks developed the degree of organization which would indicate the future scope of operations. It can now be said to be no longer experimental in nature. Experience has proven that

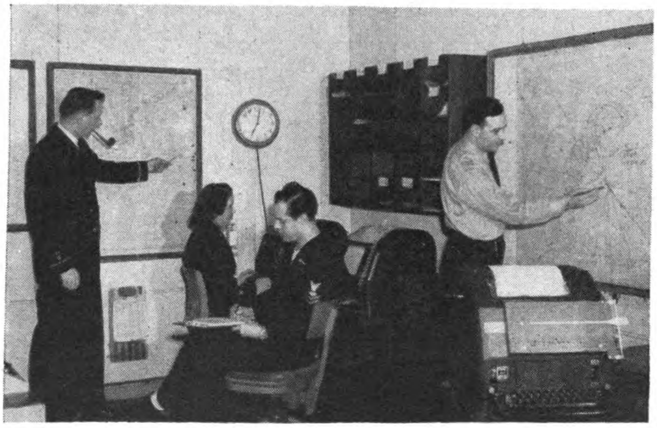
it accomplishes exactly what it was intended to accomplish. As with most highly specialized developments, several minor faults were encountered which have since been eliminated.

The prevailing methods of plotting are the results of availability of material and the habits of usage associated with them. Plotting is largely accomplished by string charts whose disadvantages may be said to outweigh their advantages. For instance:

(*a*) There is no satisfactory method of separating good bearings from poor ones when evaluating *by sight* with a string chart.

(*b*) When *lifting* bearings from one chart to another spare strings are employed and pinned to the chart board. Transferring bearings from one chart to another uses up valuable time and introduces the factor of personal error.

(*c*) *Pin point* fixes are not obtainable with present DF equipment. Every fix, therefore, is *qualified.* In its simplest form, the *qualification* is given in miles radius. Nearly all evaluation centers provide fixes



Plotting by string charts—the prevailing method. Use of these charts involves visual inspection by an evaluation officer after point of fix is established.

with a radius qualification which defines the fix as being within a prescribed circular area. This is a *rough fix* method, because the only time a fix area can actually be circular is when two bearings of equal value cross at right angles. Such conditions are seldom encountered, however, and accurate fixes must take the form of ellipses. There are but two known methods for determining the true area of a fix. One is by lengthy calculation which requires a high degree of training. The other is by means of an electrical evaluator.

As against these disadvantages the string chart system has the advantage of small size which permits many such charts to be installed. Also, string charts may be manipulated very rapidly. Roses are pains-takingly computed and constructed on sma charts.

Use of string charts involves a visual inspe an *evaluation officer.* He visually inspects t marks the approximate center of the numero marks, calls this mark the *point of fix,* esti radius which will encompass most of the cross and releases the fix thus obtained. Evaluation receive considerable advance training—occa one develops an uncanny ability to plot a fix which, however, are borne out by subsequent matical review. In important situations, rap tained fixes may be mathematically reviewed i cient number of trained personnel are availal wide radius fixes may be reduced to long range ellipses which simplify search and rescue pro thus saving time, equipment and lives. H qualified personnel not being usually available fixes are seldom reviewed. It is not uncommo 20 or more bearings to acquire a single fix. sionally, large numbers of bearings increase t culty of solving a fix. In such circumstan ability to distinguish good bearings from poor essential, and the evaluation which is obtainec colored light beams of device 1–CJ is invaluabl

A review of fixes is a necessary activity. N important cases are reviewed for study purpose prevailing reviewing procedure involves the up of miniature charts, by hand. Thus, it vantageous that a better method be devised cording plots. Use of a photographic meth valuable man-hours.

It is pretty well agreed that there are c schools of thought on the subject of D/F eva While many evaluators may continue to prefe string charts, at least until they have becon oughly indoctrinated in the use of the plotting the capabilities of device 1–CJ have been amp onstrated. The plotting of good, fair and po ings by three colors of light beams enables the tor to disregard quickly undesirable bearings the final analysis, it has been proven that plot vice 1–CJ can be photographed, with color ination, by ordinary means.

It is believed that by incorporating seve design features—such as increasing the area c to accommodate a larger number of stations—t ciples embodied in this plotting board will the maximum in accuracy in the shortest possib and further reduce personnel requirements, larly those in the highly-trained *expert* classific

From the installation of a hot-water line in a backyard bird bath—to a plan for the Japanese current, covers a lot of engineering territory. But, so does the 50-year ring background of Edward R. Armstrong, inventor of the Seadrome. Jules Verne ive been a bit more visionary, but we feel sure the slight advantage this may have im would be more than offset by Armstrong's practical realism and perseverance.

mstrong's career began in 1898 . . . 2 years of municipal engineering in Ohio, 2 years oad and levee building in Arkansas and East Louisiana. Then to east Texas for the interests where his development of well-drilling machinery pioneered the modern tech- of oil-well drilling.

1907 he went to St. Louis as a consulting engineer in automotive development . . . biles, motorboats, airplanes. There—impatient at his inability to secure the kind of he wanted—he built one himself, in his spare time, and taught himself to fly it.

the start of the first World War, Armstrong became associated with the Du Ponts— ecting the construction of their large guncotton plant at Hopewell, Va., then superin- its mechanical operation and, later, assuming supervision over all of the vast mechanical s of the Du Pont organization. By war's end, his many mechanical engineering inno- inspired the creation of Du Pont's justly famous mechanical experimental division, and ng was installed as its chief. It was here that he conceived the principle that promised l realization of an old idea . . . that of anchoring airfields in the ocean as way-stations soceanic airplnes.

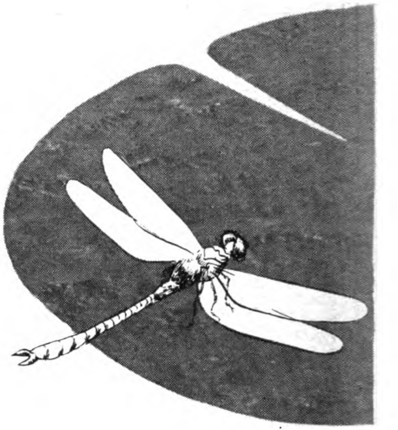
vering his connections with Du Pont in 1926 to devote all his time to the seadrome he organized the Seadrome Patents Co.

e next two decades were years of trial and disappointment. Everyone agreed it would veryone agreed it would make money, yet—nothing was done about it.

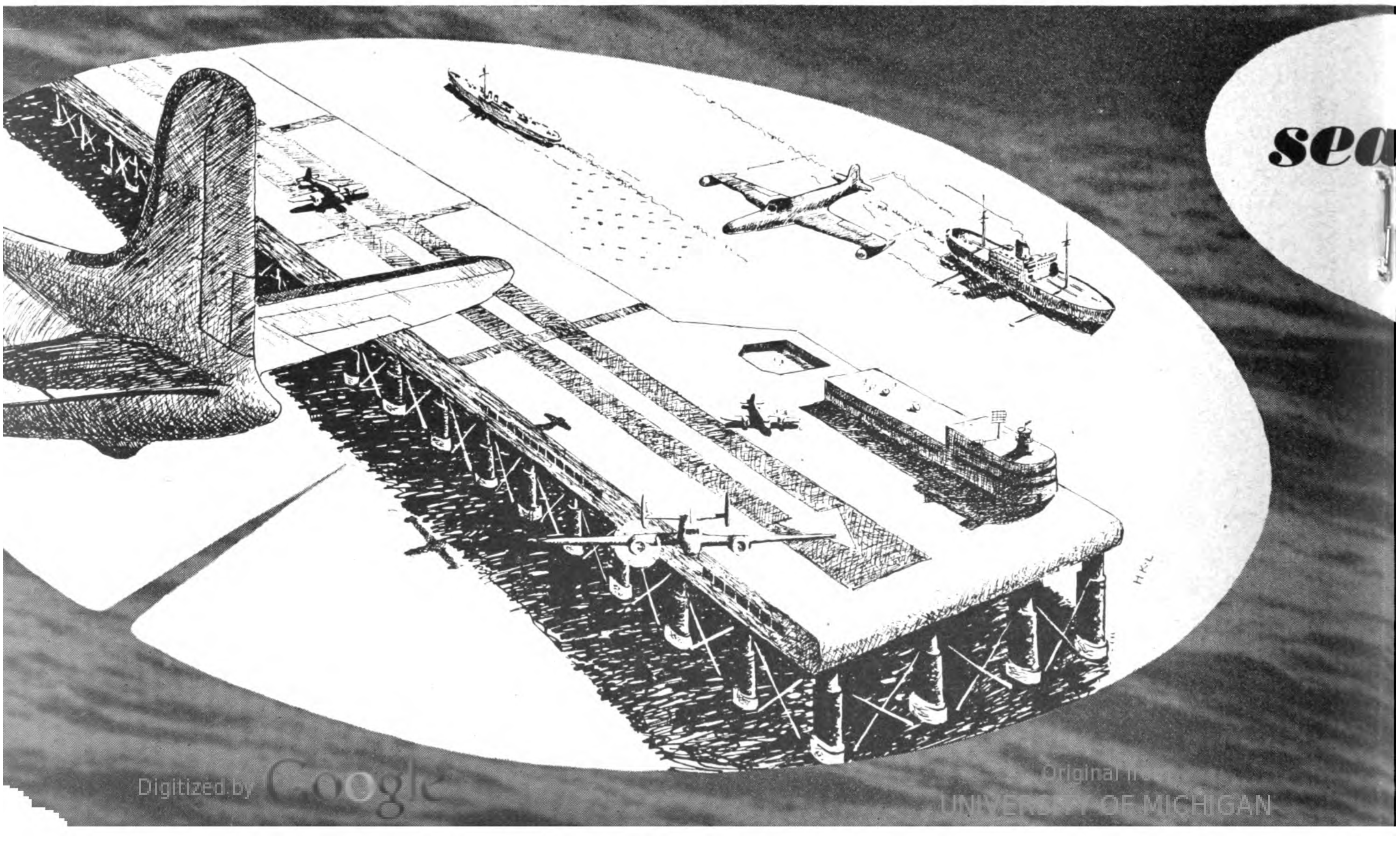
1935 the Public Works Administration became interested; newspapers gave it front l over the country, then . . . the Japanese ambassador informed our State Department the project were undertaken to establish these ocean airfields in the Pacific, his govern- ould consider it an unfriendly act. A short time later, PWA withdrew its approval. wever, a year later President Roosevelt invited Armstrong to present his case before essional committee. Airplane manufacturers argued that new types of planes would solete the need for seadromes, and the project was again shelved.

e attack on Pearl Harbor revived the seadrome idea. Anticipating a long war in the the Air Transport Command requested the Corps of Engineers to conduct an exhaustive f its possibilities. Their report was favorable . . . and now, although the war has ATC has given the green light to construct a full-size quarter section of the seadrome. ere as a multitude of practical possibilities inherent in Armstrong's vertical flotation e—most authorities agree.

is is Edward R. Armstrong's own story and we appreciate the opportunity to publish e information of Bulletin readers.—Ed.



conception of a 3,500-foot seadrome for the Atlantic route.



THE ending of the year 1945 saw the successful completion of seadrome model test experiments at the plant of the Sun Shipbuilding & Dry Dock Co. at Chester, Pa. These experiments represented the culmination of 20 years of development work.

The seadrome model test program was authorized by the Engineer Board of the War Department and carried out under the supervision of the Chief of Engineers, United States Army, at the request of the Army Air Forces, Air Transport Command.

The purpose of the test was to develop the performance and stress experienced by seadrome models in waves, on a quantitative basis, and provide fundamental information to establish the feasibility of and the design requirements for a full-size seadrome.

The original conception of the seadrome made back in 1916 was arrived at by induction, after setting up the conditions which would have to be met by an anchored floating airport on the high seas, followed by the theoretical characteristics that such a structure would require. These factors determined the nature of the experimental program required to ascertain the feasibility of the plan.

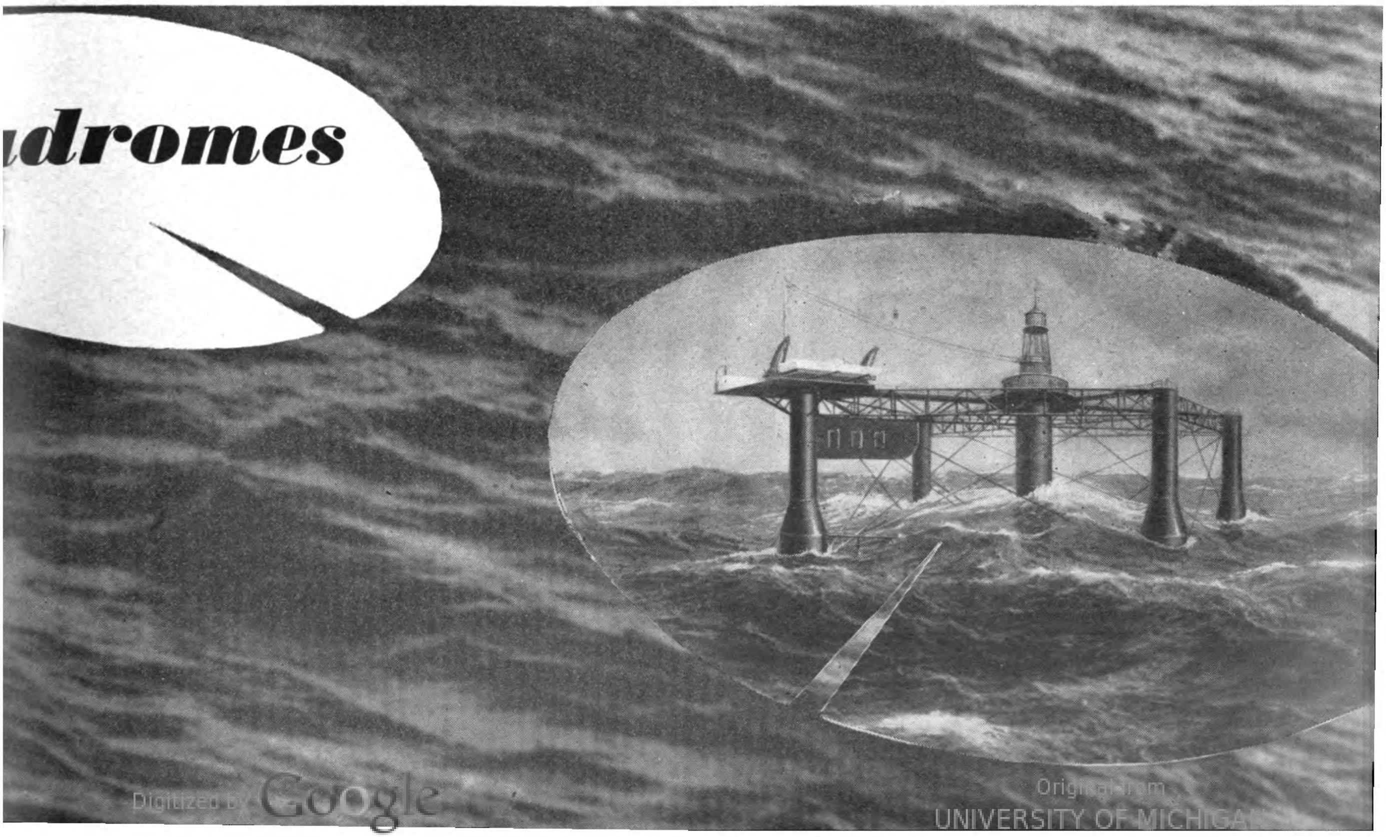
It was not until 1926 that opportunity occurred to begin an experimental program and it required 6 years to obtain sufficient experimental data to permit the design of a practical structure which would efficiently serve its designed purpose.

In 1944 the Air Transport Command becam much interested in the possibility of the use o dromes as part of the war effort. A broad stu the subject, in terms of modern flight requirement made by the Air Transport Command and th drome interests. From this study it became app that, because of the size and weight of the large p to be used over the seadrome route contemp these structures would have to be materially l than any heretofore planned—at least 6,000 f length, 550 feet in width at the airport end, an feet in width on the landing strip, and with a displacement on the order of 375,000 tons, des for the landing and take-off of 75-ton planes su the Douglas C–74, which has a total loading of 150,000 pounds.

To permit a sound engineering approach to th sign of such a tremendous floating structure, a tively new technique, the utilization of SR–4 el strain gages on model seadromes was used, so arr as to permit the accurate measurement of stress undergoing tests in waves.

The principle of operation of SR–4 electric gages is that a wire changes in both length and section when stressed either by tension or compre thereby changing its resistance. The gage co of a grid of fine alloy wire, 1/1000 inch in dia the ends of which are secured to two heavier c lead wires and cemented on a thin paper bas

Early design of an ocean radio beacon



le weighing about as much as a postage stamp. gages are cemented to the surface where the s is to be measured. As the surface to which the is applied undergoes a change in stress, the alloy grid also undergoes a corresponding strain change therefore there is a change in resistance to the ıge of an electric current. The relation of the ıge in resistance in ohms per ohm to the change rain in inches per inch gives the gage factor, as ırated by the manufacturer.

; the resistance change in any circumstance is ssarily small, electronic equipment is used to am- it so that it can be recorded by suitable means :h, in the seadrome experiments, was by means of .ectric oscillograph which recorded the strain vari- ıs on photosensitive paper, giving a permanent ltaneous record from eight different gage stations ı which the frequency and magnitude of the stresses rded can be calculated. For stress measurements ıe submerged part of the seadrome model, a prac- method of waterproofing was developed which ıitted the gages to function even if kept under r for considerable periods.

; a result of these model test experiments, ample neering data are now available to design and con- :t seadromes, both large and small, with every :ance that they will successfully withstand all the :s of wind and waves they may encounter while :ed on the high seas.

; stated previously, the experimental tests were .ed out at the plant of the Sun Shipbuilding & Dock Co., at Chester, Pa. One of the wet basins 'o. 4 yard was modified by installing a bulkhead , making a 24-foot wide channel, 200 feet long over 20 feet deep at low tide. Wave-making ıratus was constructed at the inshore end by means hich waves of various heights and lengths could be ted at will.

odel structures which were assembled in lengths om 6 feet to 72 feet, to a scale of 1/25 of full size, equivalent to a prototype length of from 150 to 1,800 feet. In addition, numerous drag tests made on single row assemblies equivalent to a ɔtype length of 2,550 and 4,000 feet. Both ; and drag models were tested in a wide range of : heights and lengths, both longer and shorter than ɔrototype wave of 35 feet high by 520 feet long, idered the largest that would be encountered at :ontemplated seadrome location.

a result of the data derived from thousands of s records and their quantitative reduction, a generalized stress envelope has developed. From this data, the approximate order of stresses induced in seadrome structural members, when exposed to the forces of ocean waves of such height and length as would be encountered by the prototype seadrome when anchored in the open ocean at the tentative site selected, has been determined.

As had been anticipated by the results obtained by some preliminary experiments on a 1/96 scale seadrome model by the Beach Erosion Board of the United States Engineers Corps, it was found that the principal stresses produced by waves in seadrome structures occurred in the horizontal struts forming the lower chord of the longitudinal truss system, a typical feature of the seadrome design. While these stresses are of considerable magnitude, they are within reasonable design limits and do not create any impractical technical problem.

From the viewpoint of stability and stress, the performance of a seadrome structure is largely controlled by the structural characteristics of the buoyancy units. The results obtained by the experimental test program largely confirm the previously held conclusion, derived from earlier development work, that by a suitable arrangement and dimensional relationship of the elements of a buoyancy unit, wave motion such as might be encountered in the open sea would have little effect in changing the buoyancy of such a unit, although there would be a considerable change in displacement under this condition. Due to this characteristic, vertical forces which would tend to produce rolling, pitching, and heaving motions in the structure, with all their accompanying stresses, are reduced to a very low order.

It is therefore definitely stated that longitudinal and transverse oscillation, normally described as pitch and roll in referring to the performance of ships, is considered negligible in all seadrome lengths that would be practical for ocean airport purposes.

To hold a seadrome on station against the drifting forces of wind, waves, and ocean currents, anchoring gear or power, or both, must be provided. Drag tests were made on the various model assemblies to determine their drift resistance in waves. It was found that in the prototype equivalent of 35 feet high and 520 feet long, the drag resistance in waves was of a relatively small order requiring neither excessive strength in the anchorage gear or in power thrust to maintain the prototype seadrome in its desired location in waves of this height and length or those of greater length. However, drag measurements, resulting from

model tests in waves shorter and higher than those equivalent to the prototype wave (35 feet high and 520 feet long, and applicable to the proposed test location), were in many instances considerably in excess of those obtained from tests in the equivalent of prototype waves.

In estimating the capacity of the anchorage gear required to maintain the seadrome on station against the drifting force of current, wind, and waves, it has been assumed that, as a precautionary measure, sufficient reserve power should be provided on the seadrome to hold it on station—except under the most adverse weather conditions and on the further assumption that during such weather conditions the seadrome might be purposely disconnected from the anchorage gear.

That as a result of these tests it is now possible to build and operate floating airports on over ocean airway routes will be readily admitted by many, that there is any economic or practical reason for doing so will be questioned by some, mostly those persons not factually informed about airplane payload carrying capacity in terms of flight distance without refueling. This seems to be the place to discuss this question.

It is a matter of statistical record that at the outbreak of the war the transcontinental civil air lines of the United States led the world in efficiency, speed, safety, and volume of traffic. It is not universally recognized that this superior position of air transport was inherently possible solely because such services were operated with relatively short flight distances between refueling stops, which rarely exceeded 750 miles, the approximate flight distance between New York and Chicago.

It is an old axiom of transportation economics that service rates must be in line with what the traffic will bear. Transcontinental air tariffs now in effect (about 5 cents per passenger-mile) are not considered burdensome by the traveling public, yet are sufficiently high to permit profitable nonsubsidy operation of our air carriers.

Conversely, in the postwar extension of air transport facilities to intercontinental routes such as over the North Atlantic and the Pacific, the public will expect rates on a parity with those found to be economically satisfactory over continental routes. Rates of this order will be necessary to attract the volume of traffic required to make such an operation financially sound. To make these rates possible, as will be shown later, the flight distances, without refueling, on ocean air routes, should be approximately the same as those over continental routes. Any procedure involves Government subsidies whi the approaching postwar era of high taxation, be a precarious basis on which to develop a industry. The only alternative would be higher rates of service, necessary to make the ve self-supporting—with the result that the cl would be so high that they would so restrict tions that, for all practical purposes, the res transportation benefits to commerce and indu the real reason for justifying the development, be unimportant.

As a means of economic transport, the ai must compete with other forms of transport ove and water such as the railway, the steamshi auto-bus, and the truck. In the end, success or f of air transport will result in direct proportion accruing benefits rendered and their cost in re to competing services.

As long as engines requiring hydrocarbon fu used to sustain and propel airplanes, the fue which must be carried for a flight distance of miles will be substantially four times as great a required for a flight of 900 miles. Common would indicate that the major portion of th required for the difference of 2,700 miles of could be made profitable useful load if thre dromes were stationed in the North Atlantic, di the route into four flights of approximately 90C each. There can be no argument against tl of seadromes but their capital cost and, as th be made available on the North Atlantic to air port companies at a nominal charge against p carried, a small part of the increased income by their use, it would seem that this argument is tively answered. Seadrome toll charges will but a small increase in the cost of airplane ope and are offset many times by the greater incon to the considerable increase in payload when pared with that carried in nonstop operation.

It seems incredible that the aeronautical eng and airway executives of the United States and countries, striving to develop long range airplai North Atlantic airways, are so reluctant to ack edge the fundamental basic and definite limit to economic nonstop airplane airway operation signers are devoting all the facilities of scienc research to improvements, the very nature of if successful in total, cannot increase the averag formance of their ultimate designs more th percent. They fail to appreciate the fact that

' seadromes on such ocean routes, the payload ·ir best designs, operating over the seadrome ı, will exceed by several hundred percent, eco- ally speaking, the load which might be attained ·ir use over the same route without intermediate ing bases.

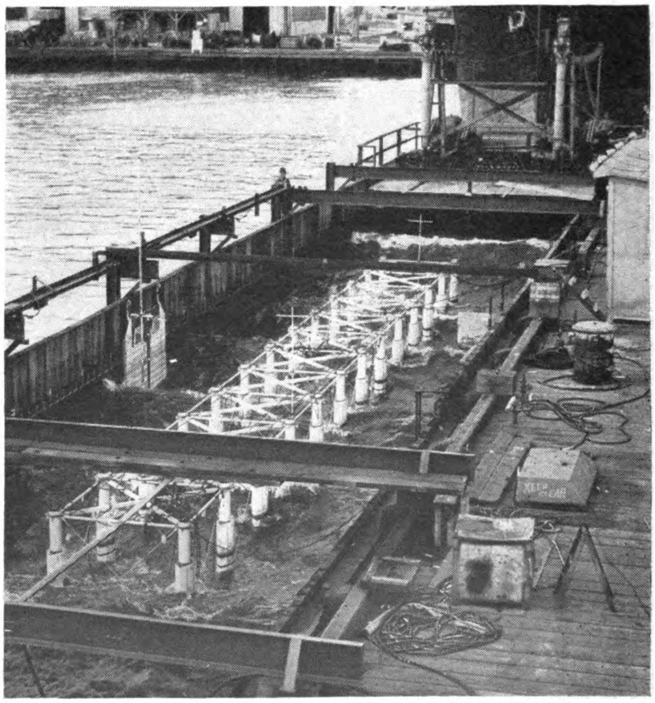
this postwar period much is expected of air ort. Visions of round-the-world carriers are indulged in—few persons appreciating the hat for every ton of air cargo carried over the utes, somewhere in the background trucks, rail- and ships must normally transport from 2 to 5 of fuel, oil, and supplies to keep the airplanes

question, "Why are seadromes structures rela- stable when freely floating among waves?" has often asked. Some of the answers are given here. h theory and practical experiment support the claim made for the seadrome structure designed rport purposes at sea—that it will neither roll, nor heave when subjected to the largest ocean , nor will it be stressed unduly by them. Such n is contrary to the usual experience with ordi- loating structures such as ships, so that those un- inted with the fundamental principles incor- ed in the seadrome design are prone to be skepti- regard to the practicability of their serving as ts in the open ocean. Such critics frequently ain that the first Atlantic gale encountered would demonstrate the tremendous destructive power an waves and reduce the seadrome to a twisted of steel wreckage which, if it did not sink, would e only as a menace to navigation. These ns are founded on ignorance of the natural laws ning the formation, propagation, and destructive of ocean waves. Even among intelligent persons hnical training there is a lack of basic knowledge is important subject. Without at least some ntary knowledge it is difficult to understand why drome is practically motionless when exposed to ocean waves which frequently endanger and ionally wreck even the largest ships.

e destructive effect of ocean waves on shores and es, harbors and docks, is common knowledge. not, however, generally recognized that the tre- ous dynamic energy contained in ocean waves nly be released by interference with their normal ments of propagation. If there is no interfer- with their motions, no energy is released to exert structive effects. It is a well-known fact among r engineers and those engaged in designing and building coast protection works that at relatively shallow ocean depths, approximately 30 feet below low water surrounding our coasts, wave motion is so slight that no destruction of coastal protection works is experienced at that depth.

Seadromes are to be located in the open ocean, therefore destructive wave action experienced close to shore, due to the shoaling of the sea, is in no way a measure of that encountered in the deep ocean. While our shores, during storms, frequently demonstrate this fact, few persons realize that among the greatest waves of the ocean their energy can only be released by interference or resistance. Maritime records amply confirm this statement. An actual experience is typical: A modern tanker which in ordinary weather steams at 13 knots with a thrust of 30 tons—in heavy weather, against waves 20 to 30 feet high, was forced to reduce speed to $7\frac{1}{2}$ knots and increase thrust to 60 tons, six times the thrust necessary for this reduced speed in ordinary weather. By turning around and proceeding with the sea, normal speed was attained at normal thrust. The explanation is simple. Against the sea the ship was interfering with wave motion, releasing tremendous energy which was expended on the ship structure. Going with the sea, comparatively little interference to wave motion was offered with no release of energy.

18-foot by 6-foot model assembly, equivalent to 450-foot by 150-foot seadrome. Note strain gages with recording instruments on the dock.



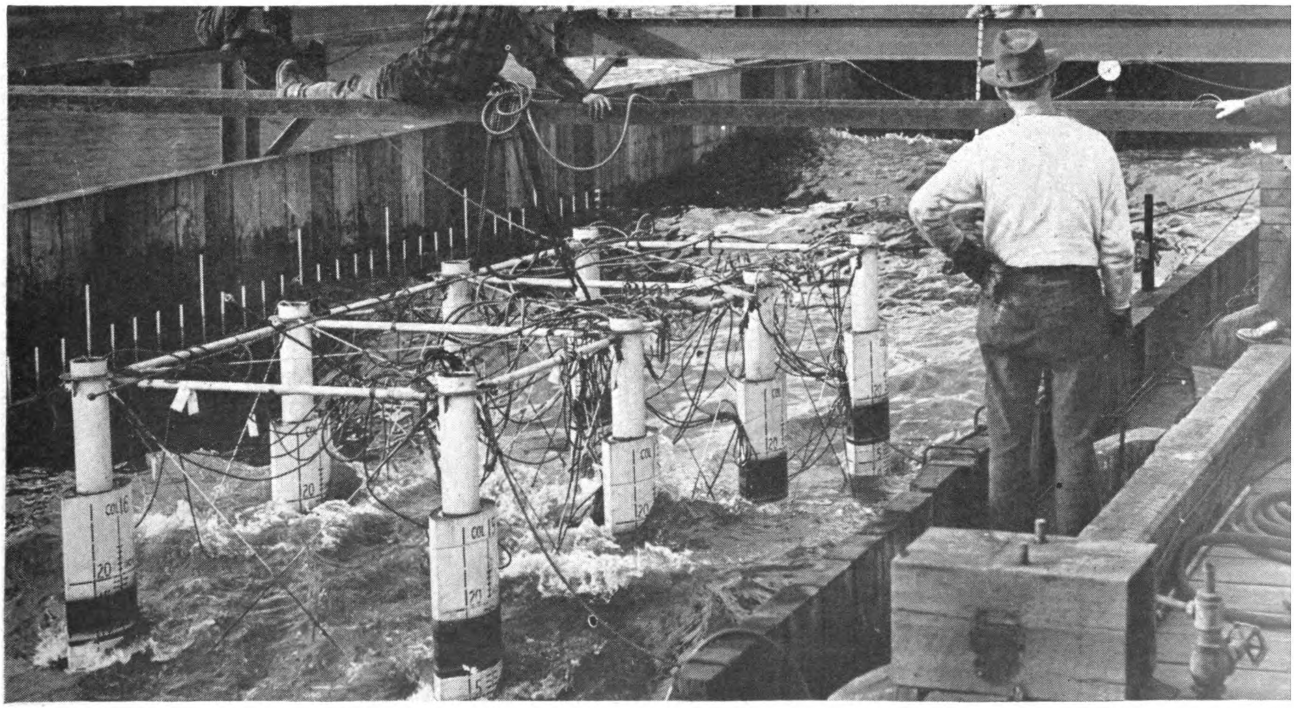
In the open ocean, waves are of two types—those produced by tidal action and those generated by the wind. Tidal waves, or so-called waves of translation, are usually of great length, as much as several hundred miles, and small height, rarely exceeding 2 feet in the North Atlantic. Such waves have no recordable effect in the ocean itself but on the shore their effects are highly destructive. Wind waves, produced directly by wind blowing over the surface of the sea in the deep ocean, are waves of undulation—that is, the form of the wave is transmitted in the direction of the generating wind with a velocity of 38 miles per hour in a 30-foot wave, but there is but slight forward progressive movement of the water, generally moves up and down in a vertical plane, at relatively low velocity, less than 3 miles per hour even in large waves, a speed so low as to be incapable of appreciable vertical impact force upon striking an object.

There are two forces operating in the formation of wind waves; one horizontal, due to the wind, and the other vertical, due to the force of gravity. These two forces produce motions which take place within definite limits, controlled by the force of the wind which produces the undulation and the depths of the water in which it takes place. In the open ocean, the depth of the water is so great that there is no interference due to the proximity of the bottom.

There are several mathematical theories rega the motions of the water particles, whose move bring about wave motion. The trochoidal thec amplified by Airy, is currently accepted as more r representing the physical laws governing their fc tion and transmission than any other. Wheth not this theory is true in every detail, no one can tion the statement that tremendous energy is req per mile of 40-foot wave to raise, in a few sec millions of tons of water well above sea level ag the constant pull of gravity. To perform this irrespective of what the correct theory may be mittedly requires greater energy concentration i water particles of the wave trough, where the up movement starts, than that of the crest, becaus force lifting the water to the crest is imparted from the energy of the trough. After these f have balanced in the crest, the force of gravity ch the mass movement from up to down.

It follows, as a fundamental of ocean waves propagated without material interference, tha normal hydrostatic pressures resulting from de heads of still water are no longer true and as tl sultant of the internal dynamic reactions amon wave particles, pressures at the same depth in diff parts of a wave will, in view of the great energ

72-foot model assembly under test in waves in test basin. Waves the equivalent of over 50 feet high on full-size se



d, vary considerably. In large waves this equiva- ıressure change may exceed 20 percent of normal, lucing a novel concept in naval engineering; of a possible variation in displacement with- ɔf necessity, a variation in buoyancy, a decrease placement being compensated for by an increase drostatic pressure combining to maintain buoy- constant.

is logic statement is amply supported by many iments with seadrome models. It is apparent eryone that ships which roll, pitch, and heave among large waves, are not constructed so that tions in displacement compensate to maintain ıncy constant. The extensive movements of in storm waves cause many of them to founder, is necessary as a practical basic principle of ı of all ships because of the inherently high on of their centers of gravity, with reference to centers of buoyancy, to make their stability de- :nt on a considerable movement of the center of ıncy. Relative movements of the center of buoy- in relation to the center of gravity operate to ıce all the motions so long associated with ships g waves.

mmercial requirements, to a large degree, have the size and shape of ships. The proportions so :d at, relatively great as compared with the di- .ons of ocean waves, obviously offer some ob- ion to their propagation, especially if they are driven against the waves. Disruption of the · motions constituting waves releases energy which rce must be expended on the object offering the ance. Thus, the movement and stress experi- l by ships is a direct result of variations in buoy- coupled with size sufficient to break up wave ɔn. Keeping in mind the fundamentals of wave ɔn and their effect on ships, a simple analysis mines the elements of a buoyant structure which loat among the largest waves without motion or from them and also function as an airport at nder all conditions of wind and weather.

DROME CONSTRUCTION

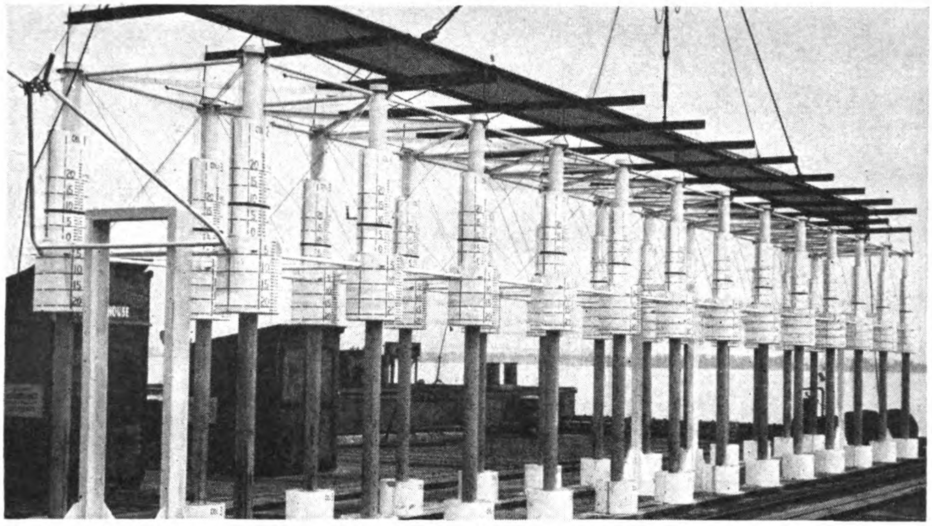
e prime requisite of a floating airport is a sta- ry and level landing deck in dimension and area ient for the safe and efficient use of aircraft types :ed to air transport over certain routes. The ı required for such a floating structure definitely ıates a conventional hull support, if other charac- ics did not. To be relatively motionless, the ıncy units supporting the landing deck must not vary greatly in buoyancy with passing waves irrespective of what changes in displacement they may have. Their relative size and spacing from each other must be such that they do not interfere with the normal progression of ocean waves through them, and finally, there being but little change in the center of buoyancy compared with a ship, stability is insured by locating the center of gravity below the center of buoyancy so that all angles of inclination brought about by wind, changes in loading, and other causes, a righting couple ample for the purpose is assured as a function of the total weight of the structure in terms of the difference between the centers of buoyancy and gravity.

The seadrome is designed to be assembled in three sections of all steel construction with the deck about 100 feet above the level of the sea. It is supported by 134 buoyancy tanks connected to the deck by means of streamlined steel columns, the whole forming a deep truss composed of tubular struts and steel cable ties encased in iron pipes. The buoyancy tanks are arranged symmetrically in rows. The longitudinal and transverse spacing of the buoyancy tanks is 150 feet. Below the buoyancy tanks, the lower columns extend about 70 feet to support the ballast tanks which contain sufficient ballast to bring the center of gravity of the structure below the center of buoyancy.

All exposed parts of the seadrome in the region of the water line and above it are of streamlined shape to reduce wind resistance to the minimum. The system of the lower columns, circular in cross-section so as to be unidirectional in water currents, is made amply strong in order to avoid the need of struts and ties which would greatly increase the water-current resistance and introduce considerable complication in erection and maintenance.

The deep-sea draft of the seadrome may be varied but normally would be about 175 feet when on station duty. Such a great draft obviously precludes erection close to shore. Therefore, in order to make this operation possible in shallow water, with a draft of approximately 28 feet, the ballast tank columns are designed to telescope into the streamlined upper columns connecting the buoyancy tanks with the deck.

In general, the deck system was designed by structural steel and bridge engineers, in accordance with specifications of the American Institute of Steel Construction. The buoyancy system, designed by naval architects and shipbuilders, is in accordance with the requirements of the American Bureau of Shipping and Lloyd's of London. Soft steel is the principal construction material and joints are welded.



72-foot by 6-foot assembly. Two rows of buoyancy units each—equivalent to a 1800-foot length in full-size seadrome—with ballast columns extended, ready to lift into testing basin

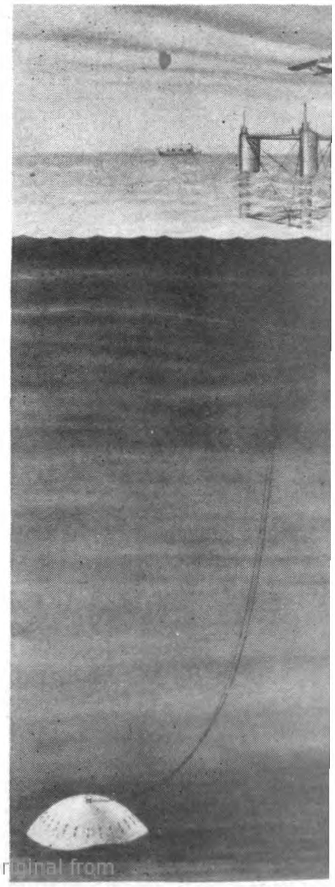
Decks and bulkheads divide the buoyancy tanks and upper connecting columns into 15 watertight compartments. For the whole structure, a total of over 2,000 subdivisions, are sufficient from a safety point of view, to insure adequate buoyancy under all conditions at sea. Provision is made to use compressed air to clear any compartment of water should it be necessary. The air system is also used to change water ballast distribution to maintain the desired water line displacement and trim. Any compartment is accessible for maintenance and repair from the inside and special paints are used to inhibit corrosion.

To serve adequately the air services operating over the seadrome system it is believed essential that the structures be maintained at their respective stations on the ocean route at all times by a permanent anchorage system reaching to the bottom of the ocean. The only alternative to this arrangement would be the use of power to perform the same service. This alternative might be a wise procedure during the experimental period. It is planned to provide sufficient power on each seadrome for this purpose for emergency use. As a regular condition of operation it would increase the operating cost unduly.

The mooring designed for the seadromes attaches to the forward end of the structures so that they are free at all times to swing into the wind, an essential condition for the safe landing and take-off planes.

To those acquainted with the difficulties experienced in anchoring lightships of less than 1,000 tons displacement in exposed positions in relatively shallow water, the problem of anchoring a 375,000-ton structure in the deep waters of the ocean appears impossible of solution. It is a [...]ter of record that the [...] tucket Shoals Light[...] moored in the open ocea[...] water 180 feet deep, 60 [...] southeast of Martha's [...]yard, on the coast of M[...]chusetts, has frequently br[...] adrift from her anchorage [...]ing storms. Anchorage [...] ship as large as a seadrom[...] the open ocean, exposed [...] North Atlantic gale, woul[...] impracticable, if not im[...]sible. The rolling, pitch[...] and heaving motions of [...] exposed to storms and wav[...] sea are so great that it is [...]lieved the restraining influence of mooring gear u[...] such condition would result in rupturing either [...] ship or the anchorage system.

It is apparent that the chief obstacle in [...] way of anchoring ships under storm conditions [...] in their movements, produced by wind and w[...] In working out the original conception of the [...]drome structure, it was considered of fundam[...] importance from a mooring point of view, as we[...] that of an airport at sea, that while it must be w[...]



Showing the method used for anchoring the seadrome

/ant, as is a ship, it should neither roll, pitch, nor /e except in a minor degree, when exposed to the force of wind and waves associated with North ntic gales or the storms of the Pacific.

he total force required to hold the seadrome on on is made up of wind, wave, and current resist- :. As a tentative proposal the anchoring gear is ;ned for a horizontal force of 500 tons. This .ld be adequate 90 percent of the time. For ex- ional conditions and to provide maneuverability mpensate for rapid change in wind direction, elec- .lly driven propulsion units will be provided total- 40,000 horsepower capable of delivering a thrust ,000 tons, giving a total anchoring force of 1,500 . Provision has been made, should emergency re- e it, to disconnect the connecting cable from the iorage buoy and maintain the seadrome on station ieans of its propulsive equipment.

ı the great depths of from 1 to 2 miles, in which ay be necessary to anchor seadromes on ocean air es, it would be physically impossible to use link n such as is ordinarily used in anchoring ships. very best forged steel alloy chains now available ld break from their own weight before they would h the bottom of the ocean at the relatively shallow h of 13,000 feet. Suspension-bridge type steel es, on the contrary, have ample strength to reach eoretical depth of 60,000 feet, or considerably be- l the distance to the bottom of the deepest ocean. ıch a cable, however, were allowed to come in act with the ocean bottom, it would not only wear rapidly, but would quickly foul itself and kink y, becoming very short-lived if used in this way in service. For these reasons, the seadrome anchor- cables will be slightly shorter than the vertical nce from the surface to the bottom of the ocean will connect at their lower ends with forged alloy chains which, in turn, will connect with the ıor. It is apparent that by this arrangement the ıal wear and tear incident to the movement over top of the anchor and the bottom of the ocean be taken by the anchor chains, and that the stress ı the seadrome will be transmitted to the anchor ıs by the anchor cables, which will always be ;ing in an approximately vertical position, under tension of their own weight, and the additional on produced by wind and current forces acting he seadrome and transmitted through the cable chain system of the mooring gear to the anchor. therefore obvious that the anchor cables will not be subject to any wear whatsoever and should, if reasonably protected from corrosion, last many years.

The anchor chains, which will be relatively short, are made extra strong in order to provide for the maximum wear to be anticipated over a period of from 20 to 30 years. A general arrangement of the anchor system and the method of putting it in place, as worked out for the service seadrome of 375,000 tons displacement, is shown in figure 3.

The anchor is a new type, made of steel, designed especially for service in the deep waters of the ocean, where the ocean bed is a level plain of wide expanse and usually composed of red or blue clay overlaid with from 1 to 3 feet of globigerina ooze.

Practically all ship anchors depend upon penetration of the sea bottom for their holding power; their effectiveness, therefore, is directly determined by the character of the bottom—for instance, in soft mud most anchors are entirely useless. Another inherent fault in anchors of the penetration type is the impossibility of predetermining their holding power under actual anchoring conditions. It frequently happens that mariners and their ships are driven ashore in storms despite the use of all available anchors.

It is a well known law of mechanics that the sliding of one body over another is resisted to a greater or lesser degree by an inherent quality of matter commonly called friction. The weight of the mass being steadily moved over another body is, to a considerable degree, a measure of the resistance encountered. It is this fundamental property of matter which has been utilized in designing a safe and reliable seadrome anchor, which might be termed a weight-friction anchor to differentiate it from the more common penetration type of anchor.

If the maximum tension that an anchorage cable or chain will be subjected to when functioning as part of a seadrome anchorage system is known, as well as the coefficient of friction between the surface of the anchor in contact with the ocean bottom, then the weight of the anchor necessary to withstand the sliding force, due to the cable tension, can be easily determined. This data, in conjunction with a due allowance for a suitable factor of safety, will give, by simple calculation, the principal dimensions of the anchor.

In anchoring a large floating structure such as a seadrome, in which the tension of the anchor cables may reach several hundred tons, the weight of a friction-type anchor might, of necessity, be considerably more than 1,000 tons, a weight difficult to handle by the means ordinarily available.

For this reason it is preferable, in such heavy anchors, to construct them with a flotation chamber and to so design them that they can be built on a shipway, launched, and then towed to their respective anchorages. Such anchors can be sunk to the ocean bed at selected locations by flooding the buoyancy chambers with the opening of suitable sea cocks.

While the under surface of the weight-friction anchor, in contact with the bed of the ocean, is designed with a substantially flat surface, the upper surface is of a spherical shape so that the anchor chains cannot be fouled or caught by it. The exit for the chains through the terminal housing and over the top of the anchor is so designed as to give a fair lead to the chains under all conditions of operation.

The under surface of the anchor, in contact with the ocean bed, is flat for two basic reasons. *First,* to reduce the landing shock when the anchor comes to rest on the ocean bed after being flooded and allowed to sink. The desired speed of fall is regulated by the number and disposition of the radial ports provided around the rim of the anchor and the number and size of the water brakes used. However, at the speed of sinking required to keep the attached cable system under control, the landing shock resulting from contact with the ocean bed, if not additionally controlled, might possibly rupture the anchor structure. By providing a large flat area, such as that shown as the bottom of the buoyancy chamber, the landing shock will be reduced to about 15 percent of the anchor weight, because, before the anchor can reach the bottom, the water must be displaced at high velocity in a horizontal direction during the last few feet of anchor travel. This, in effect, permits the anchor to come to rest with practically no shock. *Second,* to provide a large contact area which, by sinking into the ooze of the ocean floor, will substantially make the anchor part of the ocean bed, subject to the pressure of the overlying water, thus increasing its friction and resistance to movement.

At the anchorage planned, the large 1,500-ton anchors contemplated would each be subject to approximately 400,000 tons of water pressing the anchor structure to the ocean bottom, making it immovable insofar as any force it could be subjected to through the medium of the anchorage cables is concerned.

The upper end of the anchorage cables connects with the anchorage buoy, the latter being of the spar buoy type, of sufficient draft so as to function as a seadrome unit in order that under service conditions it will have but slight roll or pitch. The great weight of the cable system suspended from the buoy \
a large measure, prevent it from heaving.

A connecting cable is attached to the ancl
buoy, connecting it with the seadrome. Provi
made to retract the connecting cable on the sea
in order to bring the anchorage buoy up agaiı
seadrome at such times as the tension on the co
ing cable becomes less than a predetermined
ranging from 10,000 to 20,000 pounds. Witho
arrangement the seadrome might, under some w
and current conditions, drift upon the anchorag
or foul the connecting cable. The anchorage
are connected to a steel shaft housed within the (
unit of the anchorage buoy. This shaft is surro
by a bronze bushing where it enters the buoyanc
and is supported at its upper end by a roller-b
so that the seadrome and the anchorage buc
freely swing around the anchorage cable ter
without any tendency to foul or twist the ancl
cables. It is planned to use the anchorage buc
reel on which to transport the anchor cabl
chains to the anchorage site and to use it as a
of controlling the lowering of the anchor and its
to ocean bottom. As the cables are coiled on th
they will be spray-coated with a substantial thi
of zinc as a corrosion preventative.

SMALL SEADROMES FOR SPECIAL SERVICES

It was early realized that the seadrome
could be adapted to structures much smalle
those planned for ocean airports. For instanc
use as off-shore oil well drilling rigs in keepin
our national policy, as recently expressed by Pr
Truman, assuming sovereignty over the conti
shelf area surrounding our borders, includin
hundred thousand or more square miles in th
of Mexico.

Small seadrome units are equally adaptable
Sea Rescue Service as weather and direction-f
stations, radio and radar equipped, possibly
automatic in operation. Permanently anchor
tions of this type could serve as bases for patr
copters and the smaller search and rescue craft.
could also serve as relay stations for frequency
lation and television transmission. The sea
model tests were conducted with these ideas in

With that data now available, it is possible
sign these small seadromes knowing that th
have adequate strength to meet safely all the
tions encountered in the worst storms at sea.

of the Air Base Land
ue Squad, Elmendorf
, Alaska, set out for the
of a wrecked C-47.

SAR in Alaska

The following material is based upon a report of operations and techniques used by the Army Air Forces, Headquarters Search and Rescue Sector B, Alaskan Division, ATC. It is offered to readers of the Bulletin as a comprehensive exposition of the problems involved in cold climate emergency rescue operations, and the techniques employed to overcome them.—Ed.

THE total lack of adequate transportation facilities, poor communications, and a scarcity of population pose three principal problems for search and rescue units in wilderness areas. First, communications must be established. Second, all essential supplies and equipment must be furnished. Finally, personnel of downed aircraft must be picked up and returned to duty with a minimum of wasted time, effort and equipment.

In order to avoid unnecessary operational action by rescue forces in emergencies involving aircraft—and in other emergencies to a lesser degree—the needs of the distressed persons must first be determined. In ATC's Alaskan Division, the aircraft which is to make the first servicing contact is completely equipped and staffed for immediate action. Medical personnel, flight surgeon, surgical technician—all of them trained parachutists—first-aid equipment, seasonally appropriate emergency food, clothing, equipment and shelter, any or all of which may be parachuted to distressed personnel to cover immediate needs, are available for prompt

movement. All aircraft carry radio drop kits in special shock-absorbing containers with 10-foot parachutes. When radio contact cannot be established in any other way, these radio sets are parachuted to persons on the ground to ascertain their immediate needs, and to establish liaison between ground and air to facilitate the control of further operations.

When the need for immediate medical attention is indicated, medical parachutists are prepared to jump immediately. These men are equipped with United States Forest Service timber jumping equipment. Supporting equipment for anything up to a temporary field hospital for major surgical work is parachuted to the site designated by the flight surgeon.

If the downed personnel are unable to set up and operate a field camp, or other duties prevent medical personnel from doing it for them, experienced, parachute-trained woodsmen are dropped to the scene. Principally because of the United States Forest Service jump clothing, the type of terrain encountered presents almost no problem. Suitable areas for landing with this clothing are available almost everywhere.

Unfavorable weather conditions—high winds, local ground fog, etc., may make the parachuting of personnel and supplies impractical. In such situations, seaplane or skiplane landings are undertaken as close to the scene as possible—rescue personnel proceed overland, guided and supplied by aircraft working in liaison. In extreme situations, where it is impossible

Struggling under the weight of heavy packs, men of the rescue squad inch their way up a steep slope in unsurveyed country near Mount McKinley.—Official Photo, USAAF.

to deliver needed medical supplies by parachute son-type aircraft are crash-landed at the scene t liver the surgeon. In such instances, the pilo comes the surgeon's assistant, as well as the w man in charge of establishing the camp. Thu apparent that pilots should be trained in firs and woodsmanship. Crash landings may be su fully accomplished in high winds which would parachute operations extremely hazardous. Whi need for employing this technique may be rare considered a justifiable expedient in situatio grave emergency, even though it generally mea pending the aircraft.

In most cases of aircraft accidents in wild areas, access to the scene is extremely difficult. it is not always possible to evacuate the perso volved immediately. Since it is axiomatic that evacuation mission be based on adequate planni insure its success, steps should be taken to mak that personnel on the ground are fully prepar cope with the most severe conditions they are to encounter. In winter, particularly, severe we conditions will frequently prevent the contract ation of rescue aircraft, and seriously interfere successful liaison between guiding aircraft and land rescue units. Thus it is important to be pared to furnish the special supplies and equip needed by grounded personnel who may find it r sary to spend considerable time in the bush, and no previously prepared facilities available.

Most aircraft, crews, and passengers operating arctic and subarctic wilderness areas do carry a mum of essential emergency equipment and sea personal gear. Obviously, it is not possible fo craft, crew, and passengers to carry the ideal of e ment suitable for *all* conditions, and it is assume equipment carried by the aircraft will, unless b or otherwise destroyed, provide for basic emer requirements. However, there will be special ne in terms of shelter, sleeping bags, replacement extreme-weather clothing, and other speci items—which must be quickly provided by a s other than the distressed aircraft and crew. Wh aircraft has been downed in a remote area, it is erally considered that original emergency supplie have been expended before the emergency is reli Therefore, to provide adequate protection for th involved, it is necessary to maintain a complete level of supplies at the site. This includes food, ing bags, tents, stoves, clothing (at least one con change for each man, whether it fits him or r


teams, too, are brought into play on many rescue expeditions, particularly for overland transportation of injured personnel.

such special seasonal equipment as may be needed, d upon the estimated duration of the mission and physical well-being of the men concerned.

ocated at strategic bases throughout the area, are ks of GI equipment and special-purchase items ted on the basis of experience and technical ce of recognized cold climate authorities. This pment is not considered a *supply* within the usual y meaning of the term. It is withdrawn from ral distribution and held intact on warehouse ves, or in the form of prepared kits, and is coned by personnel responsible for search and rescue ations. Thus it is instantly available when needed.

ormally, the delivery of emergency supplies is made argo parachute. Bitter experience has taught that a free-fall delivery, a high percentage of vital plies were lost or damaged. In densely wooded s, where trees and brush cut horizontal visibility ear-zero, tree-hung cargo parachutes provide a iant marker which often means the difference ben lost and found . . . and in barren, mountainous s, the near-vertical trajectory of a cargo parachute es it possible to achieve considerable accuracy in ering supplies to a given point.

ne mission of aerial supply and the care of dised persons is a continuing one from the moment distress call is received until all personnel have evacuated. The use of special aircraft makes it ble to accomplish the evacuation without undue of time. In summer operations, the L–1 on floats lly teams up with a Norseman or Catalina. The r plane acts as a supply base, for the slower, shorte L–1 while en route. The L–1, operating from small bodies of water, provides a shuttle service e nonaccessible supply base. In winter, the same od is used except that the Norseman and Sentinal quipped with skis. The terrain of the far northareas, dotted with lakes, rivers, sand bars, and ers, provides many adequate bases for seaplanes i-planes, summer and winter.

Air crews undergo a rigorous course of training. The performance limits of their planes become second nature. They learn to distinguish and evaluate the narrow margin which separates success from failure. The continual use of the same planes on many rescue missions attests the value of that training.

On the other hand—in mountainous and heavily forested areas—the nearest landing spot to the scene of emergency may be too far away to carry out a successful air evacuation operation—particularly when injury to personnel makes it imperative that aid reach them quickly. It then becomes necessary to extend the operation to include overland rescue parties. The men who comprise these overland rescue parties are selected, equipped, and conditioned to make full use of the arts of on-foot and mechanized cross-country travel. They become experts in traversing the river bottom swamp areas, the glaciers and rock walls of the mountainous regions, and the dense brush, timber and "nigger-head" clump grass in between.

A particularly effective unit in negotiating the timber areas, in short range operations, is the M–29, M–29C, and Diesel caterpillar, bull-dozer team. The "cat" prepares a path through the timber for the M–29's, and in the bottomless muskeg swamps the M–29's team up to snake the self-burying "cat" onto firmer ground. Dog teams are useful for both summer and winter operations. A well-conditioned team of sled dogs will pull a good load over grass or stones, as well as over snow. They are particularly effective in facilitating overland transportation of injured personnel. They may also be parachuted to the site of an emergency, thus saving the time- and supply-consuming necessity of overland travel. In other words, all other means failing, manpower with litter or toboggan—slow, difficult and exhausting as it is to rider and porter—is brought into play as a part of the overland rescue operation. Wading through brush, timber, and knee-deep muskeg—or wallowing on snowshoes without benefit of trail in the winter is, however, costly in terms of time and effort.

When overland rescue parties are to be used, it is standard procedure to parachute them as close as possible to the emergency site, guiding them the rest of the way by means of air liaison. When food or overnight stops are necessary, supplies are dropped for each separate camp site. Standard life rafts, and outboard motor-propelled collapsible canvas boats are available for river crossings, and to avoid long detours around swamp areas.

In the general prosecution of rescue operations in the north, any one or all of the various phases are brought into play . . . aerial pick-up at the scene; shuttle pick-up, using special types of landing gear; overland rescue units, mechanized or on foot. High hopes for the effective use of the helicopter have not as yet been realized, though an early model, the XR–4, was used on occasion. Helicopters have not yet proven capable of effectively overcoming the weather, wind, and turbulence in which converted aircraft of even the lightest type have been able to operate with comparative ease. However, the more powerful later models, which have not been field tested in this region, offer considerable promise for successful operation.

Since the efficient carrying out of the rescue operation depends to a large extent upon the swift delivery of supplies and equipment from aircraft, in order to provide for the well-being of distressed personnel, and to relieve overland rescue units of the need for maintaining ground supply trains, considerable emphasis is placed upon the aerial supply operation.

While men and supplies have been successfully parachuted and thrown from the lighter, single-engine air transports, the greater roominess, range, stability and performance of larger types, such as the C–47 and OA–10, are far better adapted for this work. This is particularly true when conditions of distance, load and altitude, plus instrument weather from the base to the emergency site, are beyond the normal capabilities of single-engine equipment.

The use of cargo parachutes in the operation of aerial supply has been highly satisfactory. The 24-foot rayon canopy, carrying up to 140 pounds in prepared containers, is fairly easy to handle both on the ground and in the air. When used with container A–6 and bumper assembly, it has been used successfully for the aerial delivery of delicate instruments. Some difficulty has been experienced with mercerized cotton canopies. They do not open as dependably as the lighter rayon canopy and, occasionally, instead of inflating they descend as "streamers."

Smaller 18-foot canopies have successfully han comparatively durable substances weighing up tc pounds, at low and medium altitudes. How cargo delivered by this canopy at altitudes of 1(feet or more have been damaged by the rapid ra descent. Future plans do not contemplate usin 18-foot canopy for loads of more than 100 poun altitudes higher than approximately 6,000 feet.

Aerial supply delivery experience shows that an tude of 300 feet is necessary to gain full benefit of rate of descent, and to avoid loss of cargo due delayed opening of the parachute. Higher alti than 300 feet does not appear desirable becau reduces accuracy and does not materially imp parachute performance. A great increase in ope shock is to be expected at higher altitudes. It been found that the parachute attachment snap will cut a ⅝-inch sisal rope when dropped fro altitude of 12,000 feet, but that the same rope hold if the parachute riser is wrapped around the and then tied back on itself.

Except for the very large items carried on ext cargo racks, little use has been found for 35 canopies. The handling of bulky, heavy items i air and on the ground may prove difficult. Th fore, it has been found preferable to use two assem of the 24-foot canopy instead of one of the 35. is especially desirable in wilderness conditions w the depth of snow or other ground surface diffic make it hard to handle heavy units, and where frequently necessary to transport equipment o ground by the old reliable "armstrong" method.

Members of the expedition are here shown at the sce the wreck, inspecting the partially uncovered fusela Official Photo, USAAF.

AVIS-AGERE

"to direct the ship"

It is axiomatic that the development of the science of navigation has provided the greatest single contribution to marine and aviation safety. By the same token, the whole basic structure of search and rescue would fail if, when a ship sank or an airplane ditched in the middle of a vast expanse of ocean, we were unable to locate the survivors. Thus it requires no great stretch of the imagination to determine how much the men who interpret the exact science of navigation have contributed to the wartime efficiency of search and rescue—and how vital a role they will play in its future.

The author of this article, Lynn F. Sallee, is Chief Navigator of the Intercontinental Division of TWA. Born in Bowen, Ill. (population 593), of teaching parents, Sallee graduated from Western Illinois State Teachers College with a Bachelor's degree in Education, a private pilot's license, and a consuming desire to enter aviation. Driving to California he obtained a "swing-shift" job with Lockheed which enabled him to continue his aeronautical studies during the day, including flight and ground school, and special instruction in air navigation.

In January 1942 he joined TWA, serving as navigator, flight and ground navigation instructor, briefing navigator, check navigator, and finally—chief navigator. In those 4 years he has accumulated several thousand hours of air navigation in South America, Europe, Africa, Asia, and the Middle East—and has completed approximately 100 Atlantic crossings. He is a member of the Air Line Navigators Association and the Institute of Navigation.

HE word "navigator" is a combination of the Latin navis, or ship, and agere, meaning to lead ect. The word "navigation" is synonymous with in travel, whether on the surface or in the air. ring the war, the navigator became generally ar to most Americans. His role in the success th tactical and transport groups was repeatedly asized, and the future of global air transpor- is known to rest largely upon his shoulders.

v people, however, are familiar with the *science* of navigation. The tools and techniques used in directing a plane over hundreds of miles of ocean and across uncharted continents are still shrouded in mystery. The amazing accuracy that is the result of highly specialized training appears, to the uninitiated, to be drawn from the realm of magic.

Before entering into a discussion of present methods of air naviga-

tion, let us briefly scan the history of nagivation; the science which has inspired and confirmed the future of air and sea commerce by constantly raising the standards of safety.

EARLY NAVIGATION

Navigation of some sort has existed since man first traveled by water. Up through the Middle Ages, however, it was a haphazard and strange mosaic of isolated bits of knowledge, religious ritual, and the pseudo-scientific manipulation of crude instruments.

Even in the golden era of world travel characterized by the vogages of Columbus, navigation was little more than a name. Charts were grossly inadequate or nonexistent, astronomical knowledge was sketchy, instruments were crude, and very little was known of currents and tides. In fact, it was realized that perhaps the world was not square after all.

It was during this era, however, that the compass came into general use, and navigation began to develop on a scientific level. Cross-staff and astrolabe, forerunners to the sextant, rapidly followed the compass and things were looking up.

These instruments were necessarily crude, and many an extra mile was sailed, but the navigator now had the means of determining latitude, and a rough course could be steered. Armed with new tools, knowledge, and confidence, more and more ships returned safely and navigation gained in prestige.

Early in the eighteenth century, the science of navigation took a distinctly favorable turn with the invention of the chronometer and the sextant. The former assured accurate time from which longitude could be determined. The latter offered an accurate means of measuring the altitude of celestial bodies, and consequently, an accurate means of determining latitude. A ship's position could now be "fixed" with an unprecedented degree of accuracy.

The increased safety opened new vistas in sea commerce, and foreign trade boomed. As trade increased, new navigational developments were inspired and the cycle continued, each in turn stimulating the other, until safety, insured by navigation, made possible today's vast merchant naval fleets.

AIR NAVIGATION

Air navigation is, of course, a relatively new field. Based on the fundamentals of marine navigation, it was born of necessity when man undertook extended flight through the air.

The first recorded flights of any distance were undertaken early in the nineteenth century. In 1836 a balloon flew the astounding distance of 500 miles f England into Germany, but this, like other early flig was a credit to the courage of the occupant, not tc knowledge or skill.

Other fearless a nauts made succes flights in balloons later in Zeppelins, from the standpoint navigation they were controlled and the sp distance, or directior their voyages was depe ent almost entirely weather. Perhaps, if the occupants had posse parachutes, history would have recorded the vent somewhat differently.

The value of practical air navigation was gra cally illustrated for the first time, during World W Two feats were performed by German Zeppelins wl assured the future of long-range flight and proved need and value of air navigation.

The first instance, a Zeppelin loaded with sup was dispatched from Bulgaria to German East Af in an attempt to relieve beseiged garrisons. That trip was able to arrive over its destination is a tril to navigation, but the fact that it became necessar return without landing makes the flight more outst ing. Upon arrival, the country was found to b enemy hands and a return to Bulgaria, the ne friendly territory, was successfully completed.

Another instance, of equal or greater significa occurred late in the war when German Zeppelins, ing weather which grounded defense squadrons completely obscured the target, made very accu bombing raids on London. That such raids coul accomplished without sighting the target, and in s instances any known landmarks, caused an underst able concern.

It was learned that these missions had been curately directed by radio triangulation from stat deep in Germany, a range of approximately 800 m Thus radio navigation was born, and the futur long range air navigation was prophetically reveal

In the years following the first World War, co geous pioneers studied the rapidly developing sci and, armed with this knowledge, made several l distance flights by airplane and dirigible. Not among these was the round-trip Atlantic crossin the British dirigible R–34, which furnished additi confirmation of future possibilities.

:he United States, however, the development of ıtional methods and instruments was overshad- by a shift of emphasis to the improvement of ıutical facilities within the country. Air mail eing flown experimentally, and airports, airways, ircraft, and the possibilities of instrument and flight, were the topics of the day.

;-RANGE FLIGHT

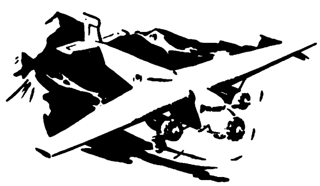
until rudely awakened by two outstanding , did the layman and the industry itself realize st possibili- ɔpened by ific naviga-

ndr. Rich- Byrd navi- by celes- neans, a from Spitzbergen to the North Pole, and having nined his position over the Pole, affected a safe ı to his point of departure. He subsequently numerous flights in the Antarctic regions, includ- 1,600-mile flight over the South Pole.

: necessity and value of navigation in safe long- flight were now irrefutable, and was further ıtized by Charles A. Lindbergh who, in 1927, fied the world by landing in Paris after a non- ɔlo flight from Mineola, N. Y.

: last decade has witnessed such rapid progress phases of aviation, that it is difficult to isolate milestones which were most significant. Fokker ord transports were replaced by the DC–3 and ɪmestic airways crosshatched the continent.

: future role of air transport, civil and military, lifficult to visualize, but the trend of future had not yet become discernible to the proper rities. Those who advocated long-range air- and predicted ceanic flight were led, even as the ss of an expand- ar emphasized the sing tactical use of ıircraft.



tunately, it was not long before the authorities to realize that their apathy had been costly, and ıll attention directed to new concepts of range, and crew composition. Instead of the short within the country, distances of hundreds of would be flown over strange oceans, and uncharted, unfamiliar continents. Few, if any, of the aids extensively used in domestic flight would be available.

There followed a period of feverish activity as equipment and training were redesigned to conform to the changing concepts. With the now famous B–17 in production, and other long-range equipment in various stages of development, it became obvious that specialists in navigation must be trained before the full effectiveness of these new offensive weapons could be realized. Disregarding precedent, the Air Corps established navigation schools and the navigator, as an essential crew member, gained official acceptance.

Even with this advance preparation, the outbreak of war found us poorly prepared for global air transportation on a scale such as was soon demanded. Military forces were rapidly expanded and special transport groups activated in addition to the tactical. Airlines were engaged under contract to supplement, domestically and globally, the air service developed by the military. Under the stimulus of absolute necessity, and in a surprisingly short time, the world was webbed with a network of air routes covering millions of miles and serving our forces wherever engaged.

The splendid records of the Naval Air Transport Service, the Air Transport Command, and the various tactical groups, are a tribute to all who were in any way connected with them, but special recognition must be accorded the navigator. Without him, the success of these operations would have been impossible, and the course of the war might well have altered.

It has been said that the war telescoped 10 years' normal progress into one, and that out of the war has emerged a force of men with the "know-how" and experience to assume world leadership in air transportation. Of signal importance in this force is the navigator, for, as the war has graphically illustrated, the safety and success of long-range and transoceanic operations are directly proportional to the precision and efficiency of air navigation.

Now, having perused the history of the science of navigation, let us proceed to a brief discussion of the methods and techniques of air navigation as presently employed . . . some borrowed from early sailing manuals, some born of the war, but all designed to increase the safety of long-range flight, and adapted to the 4-, 5-, and 6-mile-per-minute speeds of modern aircraft.

Navigation has been greatly complicated by the demands of rapidly expanding distances, but the navi-

gator has taken it in stride. With tremendous distances over water intervening between terminals, the precise domestic airway pattern with its numerous aids is impossible. Yet, for safety, navigation must be precise and efficient. Faced with the dilemma of reduced facilities, and increased demand for accuracy, the navigator has, of necessity, become a highly skilled technician. A superficial smattering of knowledge will no longer suffice. He must be trained to a state of complete mastery of the various types of navigation, pilotage, dead reckoning, radio and celestial.

In practice, these methods are used to supplement one another, as each has limitations which preclude its use under certain conditions. Pilotage is dependent upon visual contact with the surface. Celestial requires that the stars be visible, and radio is restricted or rendered useless by precipitation static or magnetic storms. It becomes evident, therefore, that the navigator must be thoroughly familiar with all, and be prepared to adapt his methods to prevailing conditions.

Lack of space precludes technical presentation of the various methods, but a brief discussion of the definitions, applications, and limitations, of each has been included. It is felt that these will give the uninitiated a valuable insight into this all-important science of safety.

PILOTAGE

Local flights under favorable conditions may be conducted solely by pilotage, following a road, river, or railroad from the point of departure to destination. Flights of any length, however, will necessitate checks on speed, fuel consumption, and other factors, so that simple pilotage is generally used in combination with dead reckoning. In the hope of making both more understandable, they have been divorced.

Air pilotage is best defined as a method of directing aircraft from place to place by reference to visible landmarks on the earth's surface. Much as the tourist follows a road map, the navigator sets the course of the plane by comparing objects observed from the plane with those shown on the map. Accurate maps, good visibility, and the presence of recognizable landmarks are, of course, essential.

For obvious reasons, use of this method is greatly restricted in over-ocean navigation, but it is a highly valuable source of information, within its limitations. Pilotage is particularly applicable to determination of points of departure from land and of landfall, and to the identification of islands or capes, should the cou lie in proximity to them.

Though not generally applicable, it is used in th and other instances whenever possible, for it off the most positive means of position determinati and does not require the time-consuming calculati of other methods.

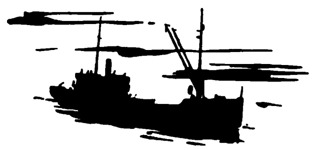
DEAD RECKONING

Dead reckoning is not as morbid as it sounds, "dead" being a corruption of "deduced," and re oning being self-explanatory. In practice, it is method of determining the position by estimation track and ground speed. This may be done by me uring drift and speed between two known positic or calculated by applying necessary corrections measured or forecast winds. It is the basis of navigation, other types of navigation merely supp menting dead reckoning, and its accuracy is direc proportional to the accuracy of the instruments us the skill of the navigator, and conditions in the air

Whenever practical, the accuracy of the estima are checked by the other means such as celestial servations, radio bearings, or pilotage. When a n position is "fixed" by other means, a new point departure is available and reckoning is revised cordingly. Thus, we may divide dead reckoning i distinct phases, the calculation of estimated speed a course to be steered, and the determination and c rection of errors in the original estimates.

The understanding of this method is absolut fundamental for other methods merely corrobor or disprove the navigator's dead reckoning.

It has the advantage of being available when lo ered visibility makes pilotage difficult; when the is overcast and celestial navigation impossible; wh flying over uncharte land or open water, a when, for any reason, dio bearings are un tainable. It is, in ot words, the one meth available at all times.



The disadvantage of dead reckoning lies in the f that it does not definitely determine position, o position has become uncertain. Once the account the ship's progress has been broken, one of the ot methods must be employed to determine a known p tion from which reckoning may be resumed.

Moreover, the plane's position is affected by wind, a factor which cannot always be accurately

ned in the air. The net result is that errors con-
y creep into the calculations; errors that, unfor-
ely, are cumulative.

: must realize, however, that without dead reckon-
ıe plane would be "lost" continuously, except for
instants when positions were determined by
means. By keeping a simple record of course,
ıce, and time, and estimating the wind, the skilled
ator may estimate the plane's position at any
ıt with accuracy dependent on the reliability of
:termination of these factors.

must not be assumed that this method of naviga-
s necessarily inaccurate. In actual practice, re-
ably accurate results can be obtained if the instru-
s are properly calibrated, and forces acting upon
lane may be accurately determined. Even now
ıments such as the gyrostabilized drift-meter and
bsolute altimeter have been developed to a point
: scientific determination of wind direction and
ity is possible under almost all conditions. Fur-
levelopments of these and other instruments may
make a position determined by dead reckoning
sitive as a celestial fix.

IO NAVIGATION

dio navigation, or radio position-finding, is, by
e definition, exactly what the name implies—
letermination of position by the use of radio
ıgs. In general usage, however, the term is
ɔyed in a broader sense to include the utilization
l radio aids available to and used by the air
ators.

e applications of radio to the science of naviga-
ıre numerous and future possibilities are limitless.
ı, when other systems fail, radio aids may be
n upon to assemble information essential to the
of the flight. Such highly valuable aids as
ranges and beacons, air-ground intercommuni-
ı, direction finders and homing devices, radio
ıass stations, instrument-approach, and blind-
ng aids, high-frequency markers, and many
s are available to all qualified to use them.

ɔm these aids, the skilled navigator may, within
;, determine the plane's position or maintain a
:d course. He may also receive time signals,
ɔrological data, notices to airmen, and other in-
ation specifically or generally of value from rou-
or special radio broadcasts.

ıfortunately, however, radio navigation, like the
methods, is subject to certain limitations.
ıgh equipment is constantly being improved and
ıces of mechanical failure are becoming increasingly rare, this possibility must not be ignored. Static is another limiting factor which has not been completely overcome. Radio reception is greatly restricted or completely blocked when flying through areas of precipitation or magnetic storms, and recent experience in higher northern latitudes shows it to be inversely proportional to Aurora Borealis activity.

LORAN

Loran is a new development and not generally as familiar as other radio aids. The word "Loran" is abbreviated from "long-range navigation" and is a system for finding the exact geographic location of an airplane in flight. Though the equipment is highly complicated, the operation is relatively simple.

Radio signals consisting of short pulses are broadcast from pairs of fixed surface transmitters. A special airborne Loran receiver intercepts these signals and, on a visual indicator, facilitates measurement of the difference in time of arrival at the plane to an accuracy of one to two microseconds (millionths of a second). The measured time difference is then referred to special Loran charts after which it may be plotted as a line of position. Similar readings of signals from other pairs of stations will also yield LOP's which may be crossed to obtain a fix. Loran lines are unique in one respect. They are stationary in relation to the earth's surface, scribing concentric hyperbolas with the transmitters as foci.

This system is capable of producing highly accurate results over much greater ranges than is possible with conventional radio equipment. Over water, fixes to ranges of 700 miles by day and 1,400 miles by night are not uncommon. Under the most favorable conditions, the accuracy of Loran fixes will ordinarily exceed those of celestial fixes, inherent error being approximately one-half of 1 percent or 5 miles at a distance of 1,000 miles from the transmitters. Under normal condition, since shorter distances are involved, the error will range from 0.5 of a mile to 2 miles.

You might feel that this is at last the answer to scientific navigation, but in its present stage of development, it is only another valuable aid, subject to well-defined limitations. The equipment is necessarily complicated and consequently subject to mechanical failure. The nature of the equipment is also such that it requires frequent adjustment to close tolerances. Unless this is done by skilled and properly trained personnel, the entire system is worthless. Static, the bane of all radio, also rears its head to prevent the use of Loran, usually when its use would be of most benefit to the navigator.

CELESTIAL NAVIGATION

By definition, celestial navigation is the method of determining position by means of observations of the heavenly bodies.

This method, borrowed from ancient mariners and adapted to the high speeds of the present, plays as vital a role today as it did in early sailing days. Instruments have been refined, and the methods of sight reduction streamlined and simplified, but the basic uses of celestial navigation remain unchanged.

Though the use of celestial navigation is limited to periods when the stars are visible, it has compensating advantages which more than justify the training required to master it. It is the one positive means of determining position which is not dependent on visible landmarks, and which does not require the functioning of complicated mechanical equipment both on the surface and in the airplane.

In the distant future, technical advances in radio may relegate it to the status of an emergency method, but as long as there is the possibility of mechanical failure, celestial navigation will be essential to safety in transoceanic air transportation.

PRESSURE PATTERN FLIGHT—AEROLOGATION

As an indication of things to come, a short discussion of the newest addition to the science of air navigation has been included. Conceived by navigators engaged in transoceanic flight and developed with the assistance of pilots, meteorologists, physicists, and many others, it is now undergoing exhaustive test under actual flight conditions.

Early in the war, as trans-Atlantic flight became a routine operation, it was conceived that the direct route was not necessarily the shortest one in point of time. As winds were known to follow roughly the isobars of pressure systems, it seemed logical to assume that routes conforming to system contours and taking full advantage of these winds could be traversed in a shorter time than routes which placed the wind on the beam or nose of the ship. Special research planes flew courses that zigzagged or approximated sign curves, and amazed those that traveled the shorter, conventional line by arriving at the destination ahead of them.

There was only one difficulty, however. Result

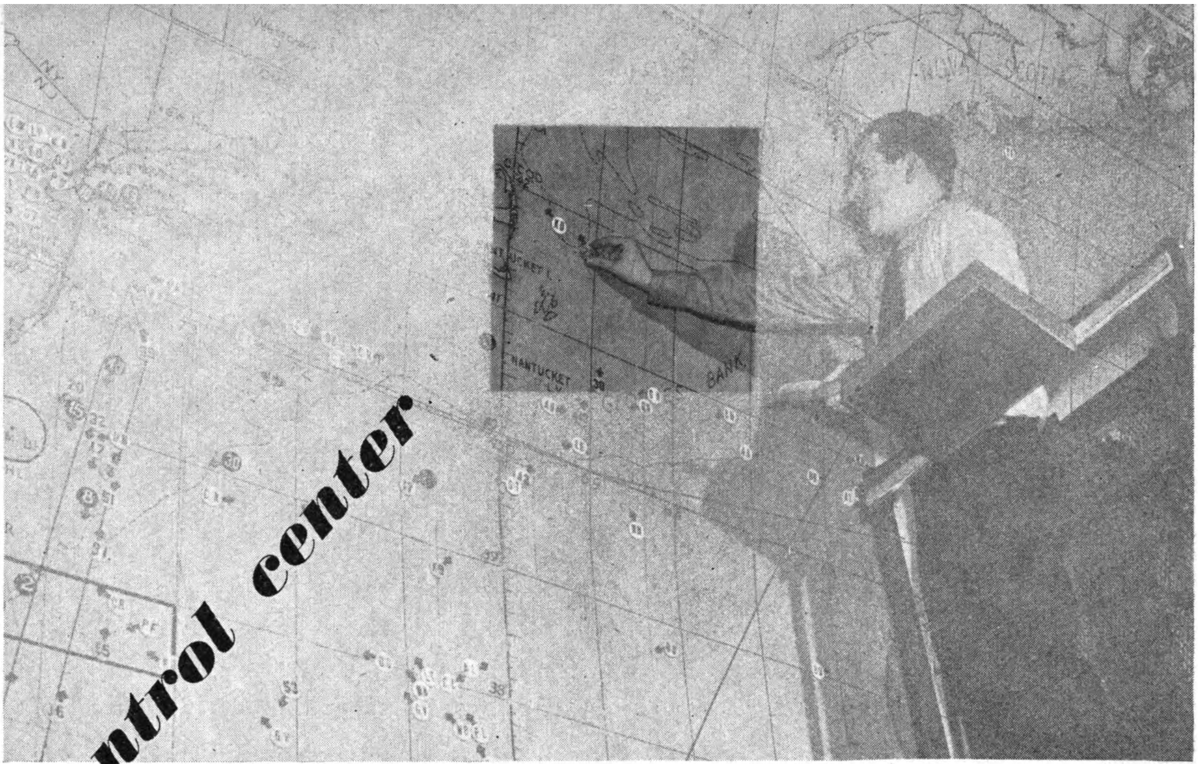
pressure pattern fli though generally go were restricted by the curacy of the forecast the pressure system. C land, where pressure re ings are readily availa isobars may be accura drawn. The forecastin the isobaric pattern h later with the system mid-Atlantic, is quite another matter.

Fortunately, just as development was stagnated, absolute or radio altimeter became available. T niques were rapidly developed and soon it was sible for the navigator to determine sea level press as well as pressures at flight level. This gave hi means of plotting pressure systems in flight and accurately following the isobars to capitalize advantageous winds. This was indeed pressure tern flight.

Aerologation is a term that has been coined to c early methods plus certain refinements that have lowed. It is an entirely different approach to fl planning and, in the sense of directing an aircraf is a completely new method of navigation. Aerol tion is designed to assure the shortest possible tim any route selected, and to ensure higher standard safety by bringing the plane to the vicinity of dest tion with a relative disregard of wind condition route. It does not alone provide a means of de mining position, but it lends assistance in the forr pressure lines of position which may be used to sup ment more conventional methods.

Preliminary reports indicate that experime flights have met with a high degree of success. new method will soon be generally released to the trained navigator another source of informa vital to the safe direction of long range flight.

By virtue of slow evolution plus the stimulatio two great wars, the science of navigation has bec complex and highly accurate. Conjunctively, the navigator has received general recognition as a ski and highly trained technician. Armed with knowledge and experience to safely "direct the sl over hundreds of miles of ocean and uncharted l he has made possible the splendid records of the p His role in the future will be equally important, safe operation, more than any other single factor, determine the future of global air transportation.



scue control center

Ships in the ESF area are plotted every 24 hours from information received from steamship companies, maritime associations, custom authorities, and weather reports. Arrows indicate direction in which ship is traveling.

The increasing number of search and rescue articles in magazines and newspapers since VJ-day attest to the avid interest of the general public in this phase of war activity, as well as to its safety potentials in the peacetime world. Until recently, censorship has forbidden publication of more than controlled accounts of some of the more dramatic and interesting cases of survival and rescue. The average citizen has seen pictures of life rafts. He knows that Captain Rickenbacker and his crew were picked up after spending several weeks on one. He has listened to returned fliers tell of ditching in the Pacific within sight of enemy shore batteries, and how by use of radio, dye marker, signaling mirror or flares, they brought planes or ships to their aid. What he doesn't know is the detail of organization and operation of the search and rescue organization that, operating behind the scenes, makes these rescues possible.

The returned flier is familiar with the facilities available if he encounters trouble during flight. He knows whom to contact and how. However, all fliers are not veterans of the Air Corps. The flying farmer, for instance, will not encounter enemy flak on a routine flight, but he can have engine trouble or run into stormy weather. Can he equip his plane with some of the equipment furnished the Army and Navy fliers? If he needs assistance, can he receive the same service that operated for military personnel in wartime? We can apply these same questions, too, to the commercial pilot who, though flying with every factor of safety in his favor, may sometime have need for search and rescue aid.

One answer to these questions lies in the proper dissemination of information to the general public of the search and rescue facilities that are still operating—that are operating not only to serve the military forces that are still active, but also to serve commercial and civilian pilots who are in need of assistance. It is with this idea in mind that this article is written.

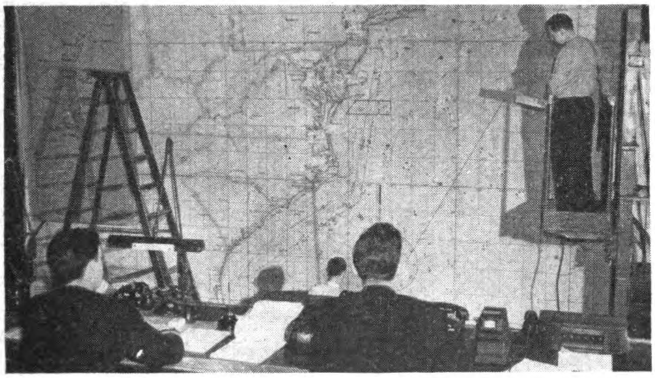
An excellent postwar picture of search and rescue can be found at the Eastern

Sea Frontier Headquarters at New York City. A few hours in the control room, the center from which the general plan of operation is carried out, will demonstrate to any layman that the necessity of search and rescue was not eliminated on VJ-day.

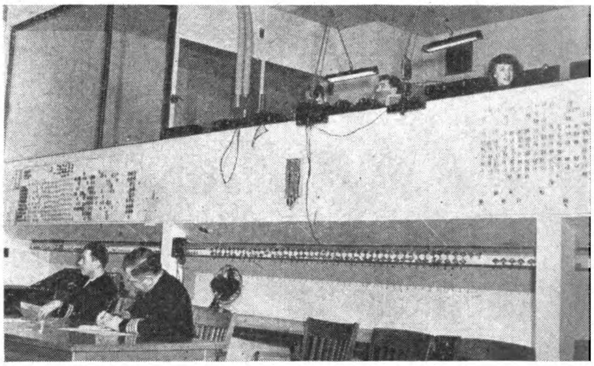
Recently an Army spokesman in a newspaper report calling attention to aircraft accidents, showed that the number of *civilian* plane crashes from VJ-day to October 31, 1945, was 70 percent greater than in the comparable 1944 period, and that during the first 6 months of this year there was a 52-percent rise in fatalities compared with the first half of 1944. Accepting estimates of some 30,000 aircraft in the country during the next 5 years, the spokesman added there would be 48,000 serious crashes in the early 1950's. It is to be noted that these figures refer to privately flown planes. The commercial air lines have long held an enviable record for safe flying.

sition of peacetime search and rescue facilities, co eration must be given to the fact that the maj of civilian aircraft will be less adequately equi than military or commercial aircraft to commun with ground facilities, or to carry out distress survival procedure in the event of an accident. weakness in the capacity of civilian pilots to take of themselves when in distress will add to the res sibilities of the search and rescue organization. obtain the maximum of cooperation from civ pilots, private flying fields must be kept fully info of available search and rescue services and the methods of activating them.

Since VJ-day many of the heretofore secret o tions in search and rescue have been made avai to the general public through newspapers and m zines, but much remains to be done in educatin air-minded public in the facilities available at



From the bridge the controller has a composite picture on the plotting board of all naval and merchant surface vessels in the ocean area to be served by the rescue organization.



The rescue controller on the bridge is in constant an communication with all the units in his rescue organiz local air stations, boat stations, the Army, Navy, and ci rescue organizations.

In November 1945 there were 3,255 airports in the country; these are spread over 53 percent of the Nation's 3,076 counties. Recently Congress authorized a 10-year building program which would almost double the number of airports in the United States, and which would put airfields in 88 percent of the counties in the country.

Figures released by the Civil Aeronautics Administration reveal a twenty-twofold increase of its inspection division. Last June the authority licensed 6,664 commercial pilots—a number greater than the total number of commercial pilots holding licenses before the war. Additional thousands of discharged pilots and aircraftsmen are awaiting examination and certification for civil aviation jobs.

One inescapable conclusion can be drawn from these figures: In determining the number and dispo-

such centers as the Eastern Sea Frontier.

The Eastern Sea Frontier was born of the nec of creating an efficient naval organization fo primary military purposes of protecting allied ping along the Atlantic coast line of the United S and creating a working organization with continental defense forces to repel enemy act Coincident with enemy successes in the Atlantic a tremendous wartime over-water air training gram, a secondary function of the Frontier Comn rescue, assumed considerable importance.

Since the end of hostilities with Japan, steps been taken to adapt the existing Eastern Sea Fro Air Sea Rescue Organization to peacetime needs the secondary function has become the primary

Located as it is in a strategic position with refe to shipping centers, commercial and overseas ai

control centers, and communication centers, :arch and rescue unit of the Eastern Sea Fron- an excellent example of the service that can be red during peacetime.

the search and rescue unit of the Eastern Sea ier a 24-hour watch is kept on the "bridge" of ontrol room. An officer acts as controller, and sistant controller acts as recorder and secretary. ommunications lines from the stations in the DF rom the Naval, Coast Guard, and commercial circuits, and the telephone or teletype connec- with the subordinate control centers and field units, terminate at the controller's desk via ione lines, or through an interoffice phone loud- er from the communication center. He also has him the latest information on availability of facilities, and on merchant ship positions. The oller funnels all distress information to the rescue ies which can best render assistance, keeps in with the manner in which they are handling the ion, and suggests additional or alternate action. kewise keeps the Air Sea Rescue officer informed important distress cases or potential distresses, confers with him on any available member of peration staff to determine the most efficient ac- o be taken on cases where doubt as to proper ing exists. He receives and records the routine :s of subordinate control centers on all cases are handled in their areas, and transmits these ls to the statistics and publications officers for sm and analysis.

:ing the controller is a large wall map of the n Sea Frontier. Here ships are plotted indi- lly from departure and position reports received various sources such as steamship companies, me associations, customs authorities, weather s, etc. Merchant ships on which no informa- available except departure and destination are d along the standard route. The ships are ated by small magnetized disks, or chits, of is colors with attached arrows which point in rection the ship is proceeding. All naval ships presented by blue chits; ammunition ships by nything being towed is a yellow chit; merchant are white—with troops aboard, the direction is green; and distresses are indicated by yellow les. Positions on the board are changed every urs.

the left of the plotting map is a map of the n Sea Frontier showing 30 airfields along the Three small electric lights grouped at each field show the flying weather for that section. An amber light indicates instrument flying, white light indicates clear, and red light no flying at all.

Behind the bridge is another chart, the Air Sea Rescue readiness board, on which are mounted miniature planes and ships showing all available rescue facilities and their location. This board is changed daily. Any current distress and the ships or planes taking part are plotted here.

In addition to these visual aids, the distress communication and evaluation center and the meteorological office all work together in order to provide the controller on duty in the control room with the information necessary to direct the efforts of the local rescue facilities in distress cases. He acts as the coordinator of all facilities in dealing with distresses in which several different rescue facilities are involved. He also must suggest any additional or alternate action which in his judgment would make for more efficient handling of the case. To do this he is in constant and easy communication with the units in his rescue organization, all local air stations, boat stations, secondary Army, Navy, and civilian rescue agencies, and the subordinate control centers of his rescue organization.

It will thus be seen that the job of the controller on watch is essentially one of gathering and disseminating distress information, and supervising the action taken on that information in order to insure the quickest and the most efficient assistance possible in every case of aircraft or ship distress in the area covered by his rescue organization.

The distress communication and evaluation center of the Eastern Sea Frontier acts as the expeditor of search and rescue. All HF/DF stations in the distress communications net are connected by teletype to one another, to the district Coast Guard office and to the control center. They form a network on which all distress information is put immediately, by whatever part of the rescue organization hears about it. This network of HF/DF or MF/DF stations are strategically located to cover the area served by the rescue organization. These stations listen on specified distress frequencies and report simultaneously to the net as a whole, and to the "radio plot," all such transmissions heard. The officer on watch then alerts the network to listen for and take bearings on transmissions from the ship or plane in distress, evaluates these bearings, and passes to the controller the "fix" or estimate of the position of the craft in distress.

In addition to the control room, ship plot and dis-

tress communications and evaluation center, the search and rescue unit of the Eastern Sea Frontier maintains an administrative force. The officer in command of the rescue organization exercises immediate supervision over its operations through the communications network. He and his staff analyze the performance and efficiency of the various parts of the organization and criticize and correct deficiencies. Their duties also include liaison with shipping companies, commercial air lines, technical research agencies, and the press. From this group also emanates the publication of bulletins of information and criticism, charts of facilities, operations manuals, and the collection and analysis of statistics on operational efficiency of the radio stations, rescue-control centers, air stations, and boat stations in the over-all organization.

Rescue operations will always be dramatic, but back of that drama as seen by an outsider lies a smooth functioning organization such as the search and rescue control center just described. Clock-like rescue operations are made possible by close coordination between air and land facilities, and by the use of good judgment on the part of a pilot who has been trained to carry out his part when he finds himself in need of help. The following incident is an excellent example of such precision:

At 0919 radio Elizabeth City intercepted a VHF message from an SB2C stating that he was circling a man in a life raft southwest of the highway bridge at Edenton, N. C. It was later determined, in this case, that an SB2C had caught fire and that before ditching in Albemarle Sound the pilot had ordered the crewman to bail out.

At 0923 an ASR JRF and J4F were diverted to the scene from local training flights. An Elizabeth City ASR PBM and the Edenton ASR crash boat were also dispatched. At 0924 the SB2C initially reporting the distress further reported that one man had been seen to parachute, and that the SB2C would continue to orbit the men in raft until ASR planes arrived.

At 0930 Elizabeth City JRF reached the scene, and the SB2C which had been orbitting departed to locate the man who had bailed out.

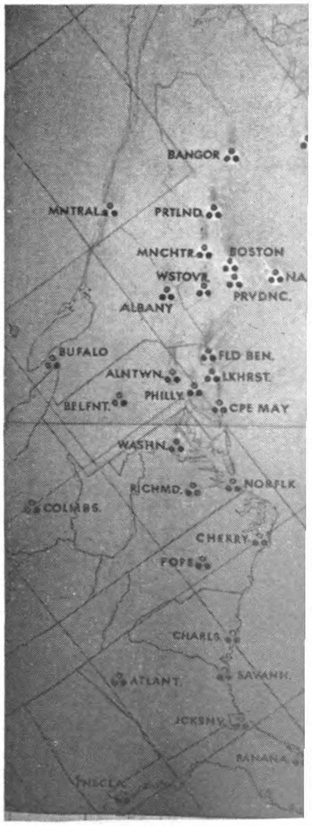
By 0932 both the Elizabeth City PBM and the J4F had arrived. The former landed and picked up the uninjured man in the life raft. His statement that the missing man had parachuted near the shore line west of Columbia, N. C., was relayed to ASR Elizabeth City. The J4F was ordered to search that area. At 0945 Elizabeth City JRF sighted the SB2C circling the area where the man had parachuted. M minutes later the J4F arrived on the scene. M while, land search parties had departed Edento 0946.

At 1000 the JRF sighted both the parachute the crewman. The SB2C which had been acc panying the ditched plane and which had assistec rescue planes in locating both airmen departed base. At 1030 J4F made radio contact with crash parties and commenced directing them to scene. Meanwhile, two rescue blimps had been patched in the event a swamp pick-up was neces Both reached the scene at 1118. At 1126 land c party rescued the crewman in the swamp and all units were secured.

All rescues are not accomplished in 2 hours the case of the above incident. In contrast, is account of a disabled fishing vessel with a cre nine who were lost for 5 days in stormy wea There is something persistent in this search busi Five days is a long time, especially after a storm eight of the nine crew members were still alive v they were found.

The words "distress," "crash," "lost" spread rap as they certainly should in an emergency. Howe search and rescue efforts can be a waste of manp

Flying weather along the ESF is indicated on a map containing a group of 3 electric lights at 30 air stations along the coast. An amber light indicates instrument flying; white light indicates clear; red light means bad weather, all planes grounded.



fuel, cause unnecessary risk to rescue personnel deprive other activities of organized protection ss the personnel requesting assistance become faır with rescue procedures, and contact the search rescue center when the emergency is over as ily as they contact it when danger is imminent.

nergencies develop more rapidly with aircraft and are more difficult to locate than surface ships. coordination and control of extensive rescue faes dispersed over wide areas requires quick action ıgh an efficient, centralized office where distress mation is pooled, evaluated, and sent out. The in New York is typical. The size of the peacejob confronting this organization is apparent. future potentialities, its operations, and the vaof assistance offered depend greatly upon civilian ctrination and cooperation.

ıe future scope of search and rescue operations is ourse, unpredictable, but certain trends can be ıly seen. Military operations proved the feasi of overwater intercontinental travel. The comial air carriers have been quick to extend their lines over these routes.

ıe Civil Aeronautics Board lists, as of March 1, , 30 United States commercial flights over the h Atlantic stemming from New York, Philadel, Chicago, and Washington, D. C. Twenty-eight ıese flights are round trips weekly and two are d trips every 2 weeks. Their terminals touch London, Paris, Stockholm, Amsterdam, Leopoldville, Natal, and Marseilles. It is safe to assume that these are only a beginning. Although the actual extent of intercontinental flight is still in the formative stage, enough planes are already in routine flight not only in our own country, but in every other civilized nation in the world, to test the efficiency and necessity of a peacetime search and rescue organization.

Since the close of the war with Japan, steps have been taken to adapt the existing Eastern and Gulf Sea Frontier search and rescue organization to peacetime needs. Consistent with the Coast Guard responsibility for rescue at sea, operation of the air sea rescue organization has been delegated to the Coast Guard insofar as it is practicable, in order to prepare for the ultimate shift of responsibility. The Coast Guard has accepted the responsibility in principle and the service is surveying postwar rescue need, but as yet no definite plans have been reached for the exact number or location of the postwar operating units.

The period since August 15, 1945, has been characterized by rapid curtailment of facilities and reduction of personnel in all services contributing to the search and rescue mission. Demobilization has resulted in discontinuance of most of the local army rescue facilities at Army air fields which had been incorporated in joint air sea rescue planning and a consequent increase in the task of the Eastern and Gulf Sea Frontier search and rescue organizations.

LL THE COST OF WEATHER SHIPS CHARGED TO AIR-SEA RESCUE?

(Continued from page 11)

with this question. In nearly every part of the d investigators have come to the conclusion that nswer lies in the oceans.

ıroughout world history men have struggled for ery of water rights and for the control of fertile ys and plains. Civilization has risen and fallen decay as the rainfall climate has changed and the ueror has destroyed irrigation works and wasted ultural resources.

ıe developments of this war have brought all of vorld's people to a clearer realization of the necesfor long-range planning to solve peacefully the ems that have been the causes of wars. The world ı better concept of the overlapping interests of le and nations. Meanwhile, science has demon-d its ability to contribute to the economy of e as well as the power of the war machine. As we cease spending billions for war we certainly can spend a few millions a year for the solution of a problem that would mean so much for the future. Without the answer to this question of weather control vested in the oceans, the unexpected longer-term variations in temperature and rainfall will turn our plans for economic security into futile gestures.

With these thoughts in our minds, we can see clearly that the need for ocean weather ships should not be defended by any single group like the air sea rescue people, the aviation industry, or maritime commerce. It is a job for all of us, but we can be thankful that while we are going about this long task of accumulating the weather and oceanographic data needed to deal with these great problems involving world welfare and security in this and future generations, we will incidentally be providing extraordinarily useful services to the expanding air commerce of the world as it struggles on to master the difficulties and dangers of crossing vast stretches of the oceans.

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AIR SEA RESCUE LIAISON OFFICERS

Eastern Sea Frontier

R. L. Burke, *Captain*, USCG
c/o Commander, Eastern Sea Frontier
90 Church St., New York 7, N. Y.

Western Sea Frontier

T. J. Harris, Commander, USCG
c/o Commander, Western Sea Frontier
Federal Bldg., San Francisco, Calif.

Philippine Sea Frontier

W. E. Sinton, *Commander*, USCG
Box 3, Philippine Sea Frontier
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Coast Guard Box #1
Navy 48, San Francisco, Calif.

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c/o District Coast Guard Officer, 17ND
Ketchikan, Alaska

Illustrating an example of emergency search and rescue communications and operations procedure when a *ditching* has taken place. Variations from this basic pattern would also apply when an aircraft becomes *lost;* develops *mechanical trouble;* is reported *overdue;* or a *bail-out* has occurred.

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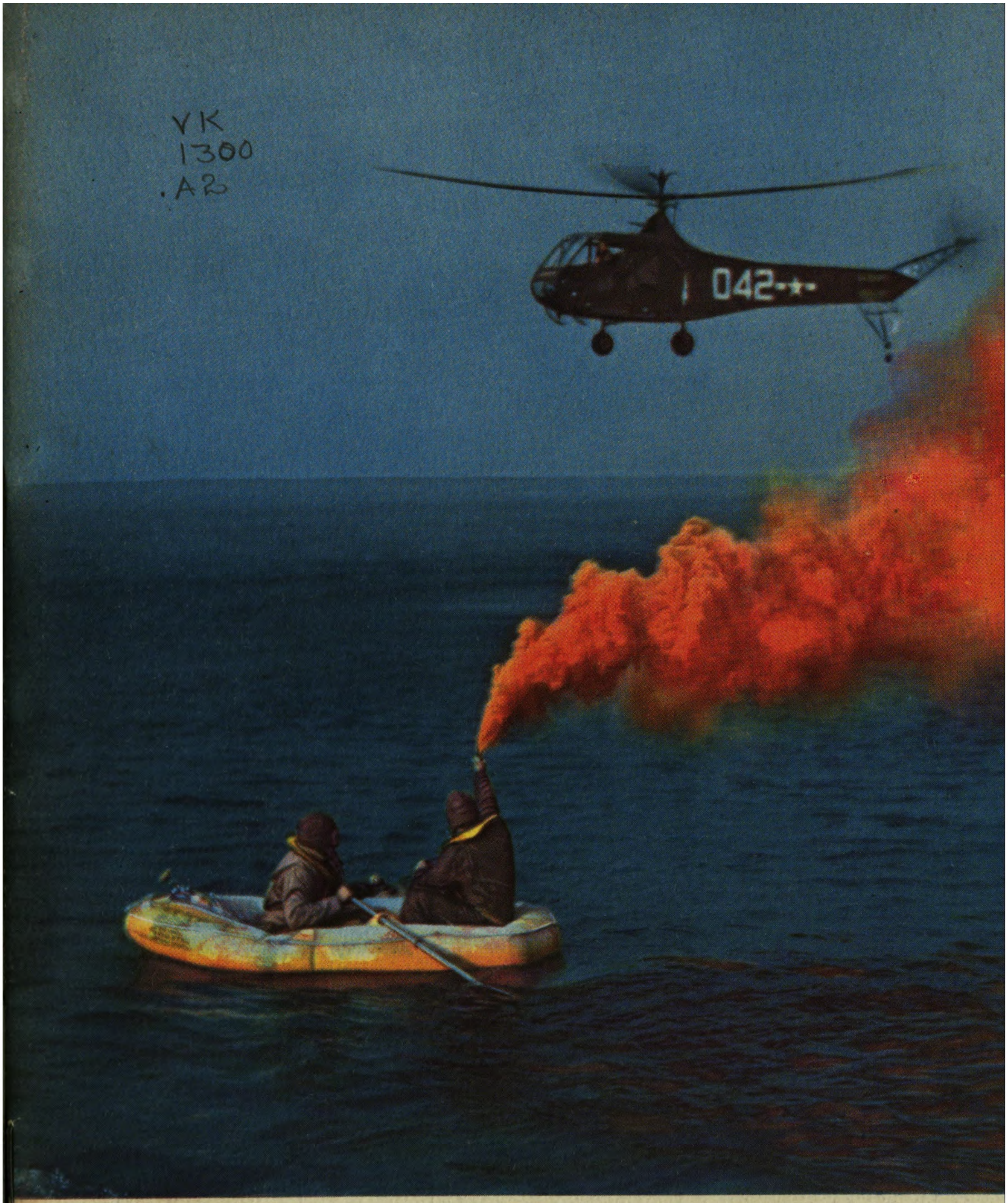

Air Sea Rescue bu

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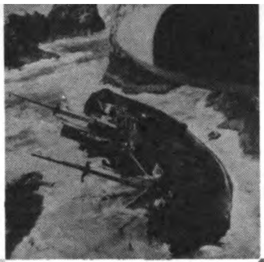
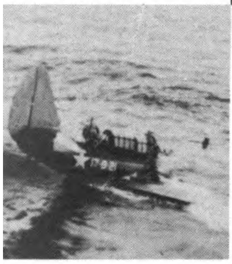


air sea rescue bulletin



formation contained herein is assembled from various United States d foreign sources; it is disseminated in this BULLETIN for information ly to a limited list of addressees with interest in the field of air-sea res- e and is not for sale. It will be apparent that the BULLETIN may contain formation which does not represent the policy of the Air Sea Rescue ;ency or the Services represented on the Board for Air Sea Rescue.

AVCG 128, VOL. III, NO. 6, JUNE
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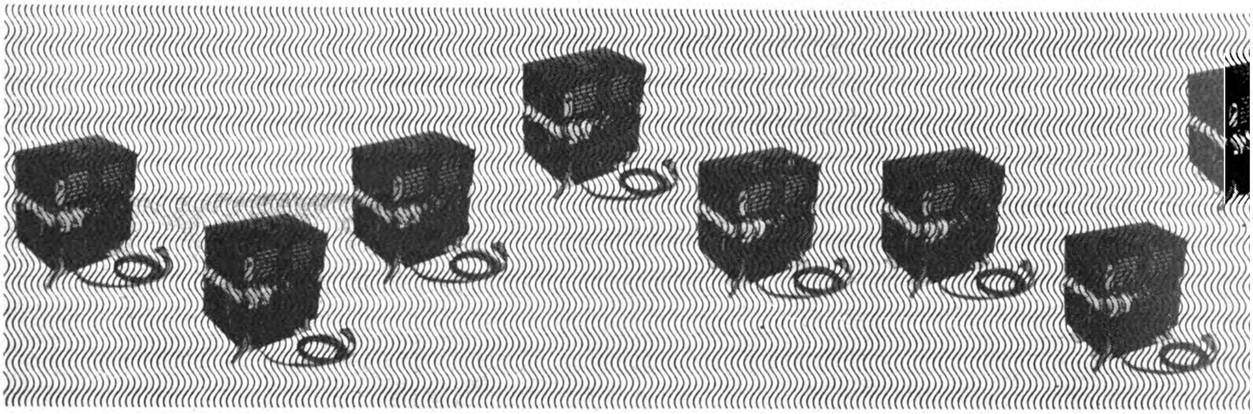
Page

THIS MONTH'S COVER: Symbols of the advancements in the science of search and rescue . . . the helicopter, and the orange- [illegible] hand smoke signal, time- [illegible] locating survivors [illegible] urtesy of *Aerial*

Ensign W. H. Yates, USCG, is Electronics Officer attached to the staff of the Air Sea Rescue Agency. At the time of his enlistment in the Coast Guard in 1941, he held Radiotelephone (1st Class), Radiotelegraph, Class B Amateur, and Radio Station W6SWW licenses from the FCC. After attending several service radio schools, and a period of sea duty aboard the Sea Cloud, he completed courses of instruction in electrical and radio engineering at Texas A & M; radar and airborne radio material at the NATTC, Corpus Christi, Texas; racon material at the Navy's Fleet Racon School. He attained the rank of Chief Radio Technician (ART) while at the Coast Guard Air Station, Elizabeth City, N. C., where he supervised the construction of the racon station. Ensign Yates was commissioned upon graduation from the Coast Guard Academy in August 1945 and served as communications and radar officer on the Escatawpa until his assignment to the Air Sea Rescue Agency.—Ed.

On the Standardization of International Distress Frequenc



The subject of a standardized system of intercommunication between aircraft and surface vessels is not a new one. It has been discussed at many conferences, in many parts of the world. It was never seriously questioned that there was need for establishing a system of direct radio communication between aircraft and vessels at sea for safety purposes—and it was generally agreed that whatever the system, it should encompass the greatest possible number of aircraft and surface vessels. However, the question of what kind of a system it should be presents a complexity of problems . . . problems of cost, weight and other important factors which, so far,

have blocked a practical solution. Yet the not closed—and it is certain that out of a co frank presentation of views and ideas will c answer to the broad problem of standardized tional distress frequencies.

The present international radio regulations for inter-communication on a wave band of 5 originally set up for marine distress. With development, it was set forth that this frequen be used by aircraft as well as surface vessels.

In those days (about 1927) there were n planes in the air and the problem was not as

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today. It is generally agreed, as the result of rience of the past decade, that the 500-kc frecy was not suitable for aircraft. Excessive ht, for one thing, was an important deterrent. ; it was proposed that another distress frequency ıtablished which, in addition to being more prac- for aircraft, could also be used by surface craft he same purpose. Such a high frequency chanif set up, will perform a valuable function in the of search and rescue.

order for a rescue operation to be successful, fundamental steps become necessary imme-ly. First, the rescue coordination center, which nding by with organization and equipment ready ıse, must be alerted. Second, the rescue unit be able to fix the scene of emergency quickly. is axiomatic that a basic consideration in the f any radio system is a prior understanding of the ıencies to be employed. Thus it becomes obvithat the higher the degree of standardization ved in setting up emergency rescue frequencies, nore practical and valuable they become.

gh frequency manual, semiautomatic, or autoc transmissions from a distressed aircraft, and the ɔtion of these transmissions by high frequency nd direction finders, form the two elements of ɔrimary system which alert the rescue units and ide them with the information they need to fix ocation of the emergency.

w frequency transmissions from aircraft are, nor-/, of very short range because of the poor radiatqualities of the aircraft transmitting antenna. ' suffers from the "line-of-sight" limitation. ;, with these two systems lacking the fundamental ntages desirable from a practical standardization point, HF becomes the subject for present conation.

hile the ground D/F net may be used for emer-/ navigation purposes, even though other facilire available, it is not believed to offer any adıges toward standardization as part of the facilifor routine operation. The present system of ɔ-ground transmission over long distances is slow inefficient and, since the operation of D/F nets nparatively complex, their capacity for handling gency traffic is inadequate. In order to obtain isfactory two or three line-of-position fix, transɔn Girl to the ground D/F net, duplicating the ary system's transmission.

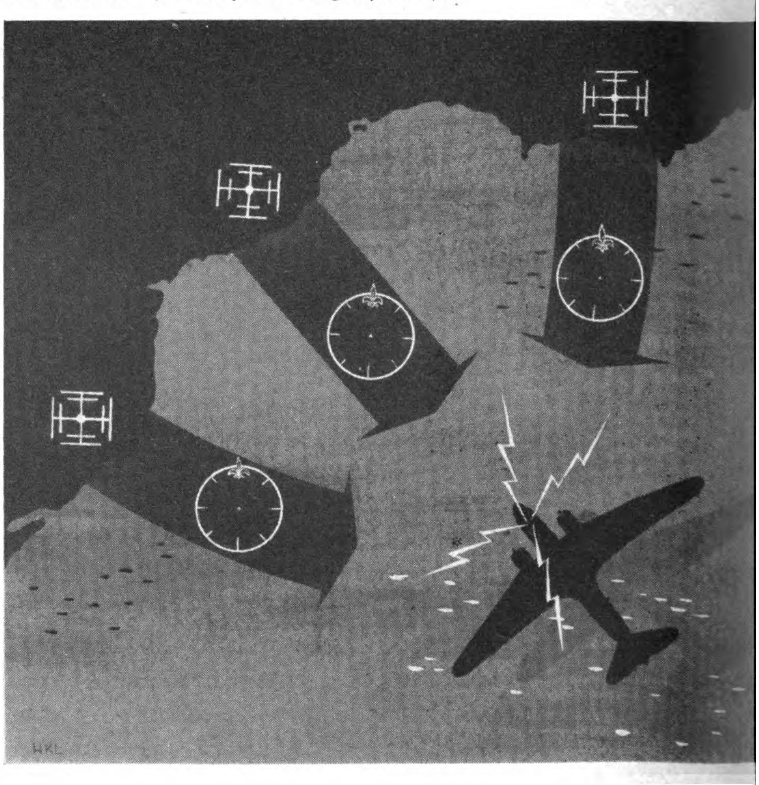
Medium frequency signals transmitted from the mitting and receiving channels must be clear and completely operative.

Since the primary system must operate dependably in the brief time elapsing between the formation of the emergency, and its culmination in a crash, bail-out or ditching, the ever-present possibility that it may *fail* to function must be considered. Thus, a secondary system is provided which, in addition to duplicating the functions of the primary system, performs two added functions on other frequencies, and for an indefinite period of time. The first and most vital of these is that of leading rescuers to the exact scene of emergency, after the general locale has been fixed. The second is that of providing for communication between rescuers and distressed personnel.

Included in the secondary system are four distinct sub-systems and, from an analysis of their operation, it appears that no practical advantages will result from the use of HF CW transmitters, radar corner reflectors, or radio and radar buoys. (A full test of the application of the sonobuoy to search and rescue is still in process of completion, therefore an accurate analysis of its possible value cannot yet be made.) The four sub-systems of the secondary system are:

1. High frequency signals transmitted from the

Aircraft needing assistance commences automatic distress transmission (Primary Alerting System).



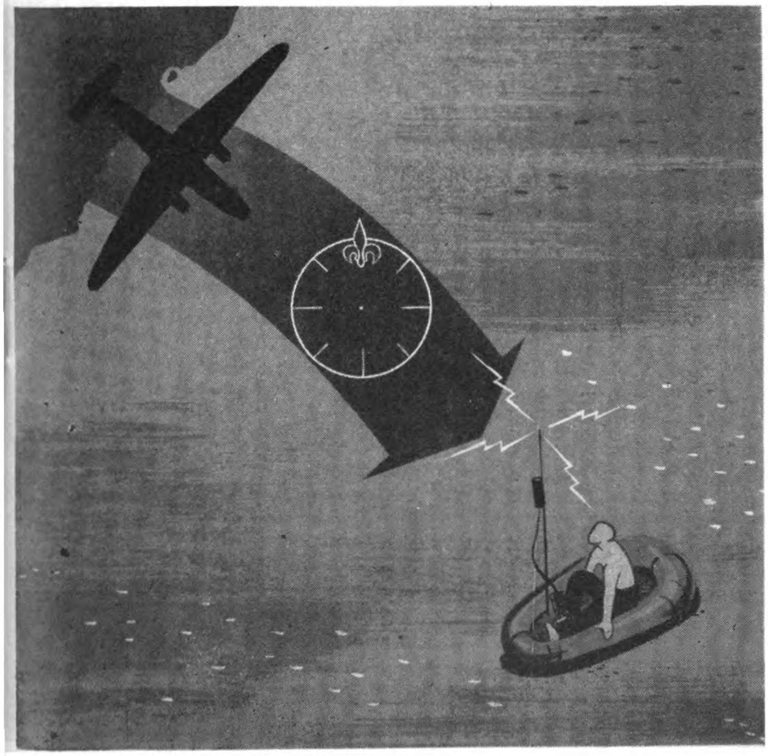
Gibson Girl and received by radio compasses of mobile searching stations—on land, water, or in the air.

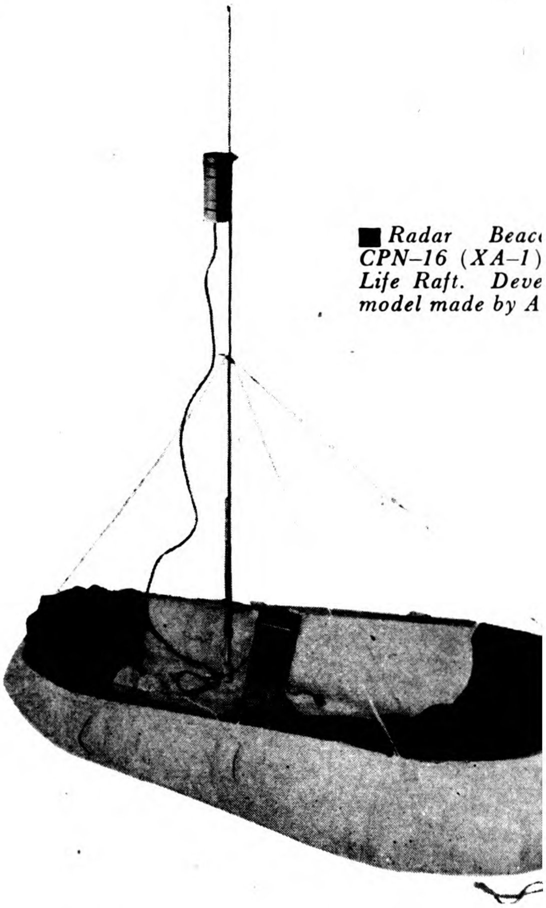
3. VHF transmission and reception by means of a miniature unit which not only provides a means of communication but, if the rescuers employ the recommended VHF homing devices, furnishes directional information. (The miniature units referred to are separately in process of development and test by both the Army and Navy). In order for this system to be of practical benefit, an international VHF frequency would have to be established.

4. Secondary radar beacons, operating with distance—measuring equipment, provide additional information for the guidance of rescue groups. Even though the range of present equipment is limited, it is useable, and with the development of the miniature equipment referred to in the preceding paragraph, increased range and effectiveness are expected.

The Army's experience during the war indicates that many aircraft which encountered distress situations on long distance flights, transoceanic or otherwise, were unable to transmit emergency signals while still airborne. This resulted in searches being made over unusually large areas. In many cases, rescue of personnel was delayed or unaccomplished.

Rescue aircraft homing to location of survivor (Secondary Alerting System).





Radar Beac CPN-16 (XA-1) Life Raft. Deve model made by A

Likewise, civil aircraft flying at conventi tudes are up against the same element of tween the inception of the emergency and clusion. If immediate action is not taken, i impossible to send a distress signal. The ra ator may not have time to tune to the proper fi

Thus the Army believes that all aircraft distance flights should be equipped with a lightweight, automatic keyer which will on a suitable transmitter (2) choose the *pr* distress frequency (3) key the transmitter to following signal automatically: *Three SO aircraft identification, and a long dash for u ground HF/DF net.* If a multi-channel ty craft transmitter is used, an automatic keyer incorporated to perform the automatic function with but little modification. If done, it would be necessary to allow 30 se the transmitter to change channels to th distress frequency before starting the transn

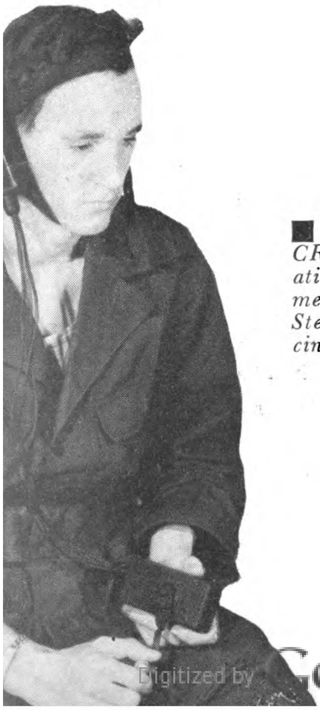
Such a device would make it possible rapid and accurate fixes on distressed air the function of sending a distress signal i

al operation by the radio operator, it may not ıt at all.

ewise cognizant of the frequency-change and ag elements involved in the use of the regular ft transmitter, the Coast Guard has also initiated elopment project designed to overcome them. models of a small, automatic transmitter (Model 26–A) have undergone extensive tests with good . At last reports, the unit weighed approxi-y 24 pounds, but it was felt that with a stand-ıtion of search and rescue requirements and encies, considerable further savings in weight be effected, and the automatic keyer added.

is Coast Guard transmitter would be used in nction with the HF/DF nets. In an emergency, craft equipped with it would simply turn on an ency switch and start transmitting automatically, ansmitter having already been set up on the d frequency. With a standardized HF/DF dis-and watch frequency, accurate bearings on the ssed aircraft could be obtained almost imme-y. Under such a system HF/DF would be con-d primarily with air sea rescue and could be d to maximum performance on the standardized ency.

utine navigational information could also be ied by the HF/DF stations, although the com-cation procedure would be somewhat different. stance, a pilot requesting a check of his position vork his own ground control station which, in would contact the HF/DF stations for a fix. this method entails some delay, it is not believed objectionable in the case of a routine check. Immediately upon furnishing the check bearing on the requested frequency, the HF/DF station would return to the emergency frequency.



■ *Radio Beacon AN/CRN-16 (XA-4) in operating position. Developmental model supplied by Stegman and McMath, Cincinnati, O.*

Considerable skill and training are necessary to the efficient operation of D/F equipment. The operator must have acquired a comprehensive working knowledge of it in order to properly interpret and evaluate the bearing indications which have been received. While the actual taking of a bearing requires but a few seconds, minutes may be needed to evaluate and plot the bearings in order to "fix" the position of the distressed aircraft accurately The servicing and maintenance of D/F equipment also require a high degree of skill and experience.

Radio direction finders for fixed station work, to enable the *fixing* of airborne transmitters, have been extensively used in America and Europe. These fixed stations employ a rather large antenna system for HF direction finding with a goniometer arrangement—either electronic or mechanical—for determining the bearing. Type SCR–291, for example, has been procured in large quantities in the United States: in Canada, a dual-channel radio receiver, the CRDF, was popular; and in Britain a similar D/F with dual-channel receiver—the Plessey D/F—was widely used. Type AN/CRD–2 was recently developed in the United States to replace the SCR–291. It incorporates a mechanically-rotated inductive goniometer and a completely electronic associated bearing indicator, as in the dual-channel D/F's.

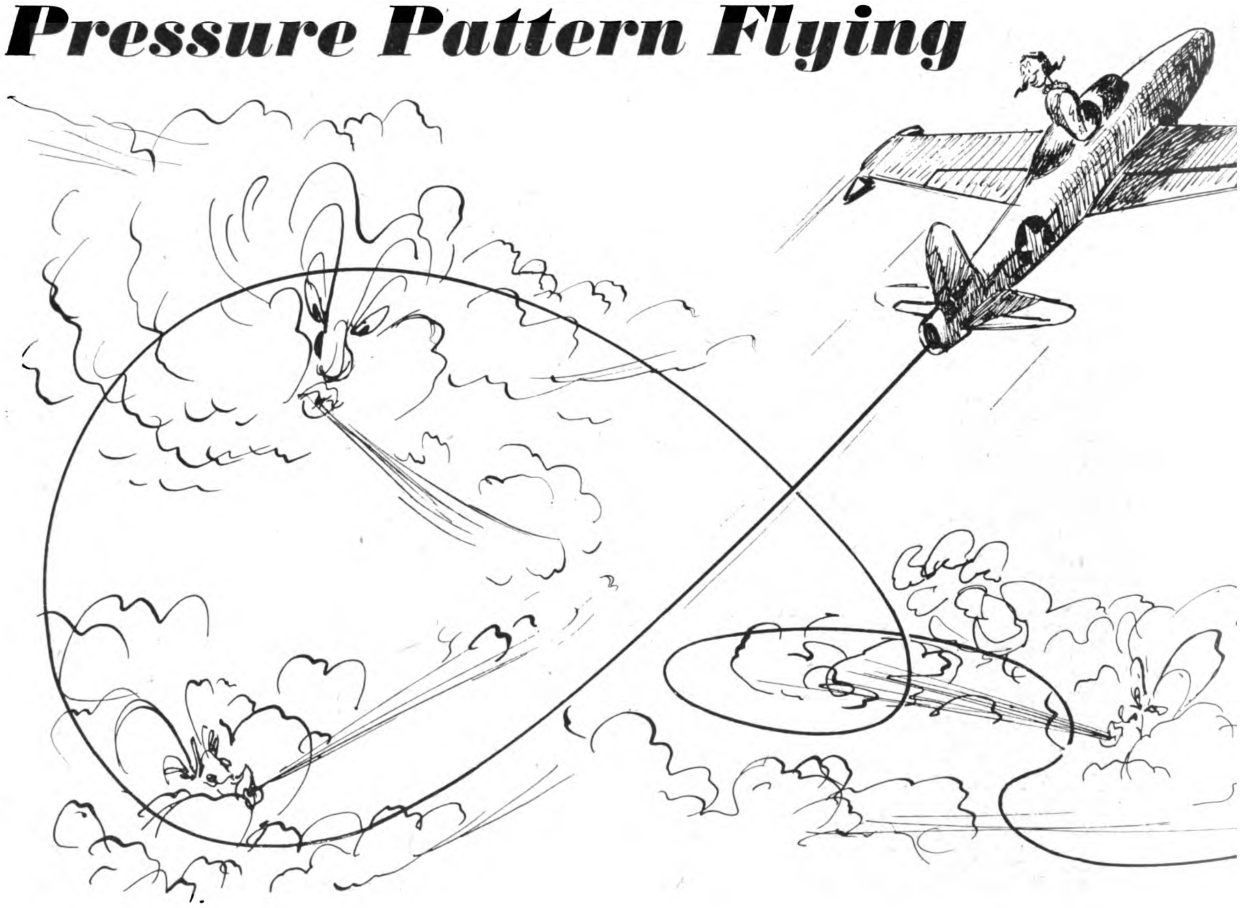
An increase in the signal-to-noise ratio would be gained, in our present systems of HF/DF equipment, by tuning the antenna system. It is realized that this will not always be practical because the antenna is generally located some distance from the radio receiver. It may also result in bearing inaccuracies due to the difference in "Q" between the E–W and expected. It is well to note, too, that if the antenna system an improvement of six DB may reasonably be expected. It is well to note, too, that if the antenna is tuned to peak, it would be at a designated frequency. At this frequency it would achieve maximum efficiency, thus further emphasizing the need for a standardized emergency frequency.

The use of a panoramic adapter with present HF equipment would greatly simplify watch on any frequency. This type of adapter is presently available, and its addition presents no installation problem. It

(Continued on page 33)

Robert W. Craig, native Iowan, joined the U. S. Weather Bu junior observer in 1931. After periods of service in Wichita, Kansas Texas; Syracuse, New York, and Akron, Ohio airports, he was assign District Forecast Center at San Francisco, and was later appointed assistant fi service officer for the California Fire Weather District. Early in 1941, Craig ferred to Washington as National Fire Weather Service Coordinator. During the w sisted in the development of numeral ciphers for the secret transmission c information. As special assistant to the Chief of Division, he tr Mexico, Central America, Portugal, Ireland, and England on weather and communications for United States air trans attended the PICAO conferences at Chicago and Mont former as United States meteorological representative, as alternate to the Assistant Chief of the Weather Bı addition to his present section chief assignment the Weather Bureau's liaison representative to and CAB.

Pressure Pattern Flying



Unless he is in a big hurry, man always travels the easy way. There is an old Spanish saying, "It is better to go around the mountain than to climb over it." From the days of Prince Henry, the Navigator of Portugal, when modern men began to move over really long distances, considerations of speed, directness, safety and comfort have the choice of transportation routes. Now current emphasis on the possibilities of "pre tern flying", which, in brief, is the idea of a great circle or rhumb line course between point and destination, but a course fitted t

of the pressure areas as they appear on the ıer map of the day of the flight.

e aviation press has frequently carried explana- of the mechanics of applying the current day's ıer knowledge to flight planning. In this dis- ın, some problems of search and rescue as it is ed by pressure pattern flying will be brought up.

short historical review of the development of pressure pattern" idea shows that it is very old. Portuguese, who were attempting to reach India ı in the 15th century, crept along the west coast rica until they found that the Continent had a end and could be turned. It was only a short then, until they were running regularly to India. e Henry, meanwhile, sat at home and pored over ɔg books. He soon discovered that by swinging of Africa, almost over to Brazil (which was still covered), his sailing ships could take advantage ɜ trade winds and, thereafter, of the westerlies ɜ South Atlantic.

is wind system, of course, was the result of the ıre distribution north and south of the Equator ı was fairly static and dependable. It enabled ʼortuguese mariners to by-pass the light winds ıe African Coast and make better time to India.

th Columbus' discovery of America, came the great long-range transportation problem—that ıversing the central Atlantic in both directions. small Spanish galleons were pushed around by ʼinds until the Spaniards, by trial and error, dis- ed the wind system of that part of the ocean and advantage of it.

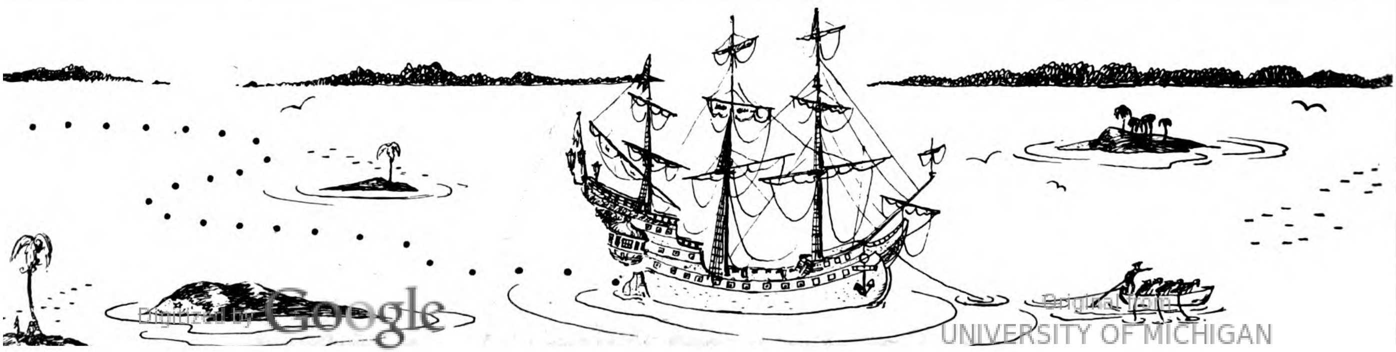
ıen the northern European nations began to North America, they had not only the winds which to contend, but also the Gulf Stream, the ador current, and the ice floes and icebergs of ıorthwest Atlantic ocean. These voyages were erous in the extreme, and food supplies often ;hort because of delays caused by weather and nts. Continual study of the winds and other rs increased the safety and shortened the time ınsit, just as similar studies are doing at present ıodern air transport. Benjamin Franklin charted the Gulf Stream in 1795 and issued advice to sailing captains on how to take advantage of it when sailing east, and of the Labrador current when they were westbound.

In 1898, after some years of negotiations and suggestions, representatives of transatlantic steamship lines met in London and completed an agreement on steamship tracks across the North Atlantic, which varied depending on the seasons. The main object of this arrangement was to prevent collisions between steamers, sailing vessels and icebergs. The tracks reflected the average weather conditions of the various seasons as nearly as possible, taking the other factors into account.

When the air became a new medium of travel, the lack of navigational technique and the inability to carry sufficient fuel barred long-range flying for a

considerable period. After 1915, however, both inadequacies began to be broken down. The first dependable long-range air transportation was by means of the dirigible. Although first honors went to Alcock and Brown for an Atlantic crossing by air in their small plane, the British dirigible R-34 made history by a round-trip crossing in July, 1919. The westbound flight took 108 hours; the eastbound, 75.

An able meteorological officer was on board the R-34, receiving weather reports from two British Navy vessels stationed to the north of the course, and from Newfoundland and Ireland. Pressure readings, for altimeter checks, were also received from commercial vessels, in spite of such limited radio ranges as 25 and 30 miles! With full cognizance of the



general weather distribution along and to the sides of the flight path, full advantage was taken of the pressure pattern in what was claimed to be the first recorded pressure pattern flight of an aircraft. Helping winds from a high pressure area over the British Isles were followed by good tailwinds on the north side of a low pressure area met in mid-Atlantic on the westbound flight. On the return flight, tailwinds were obtained from New York almost to the Irish Coast by use of the south side of a low pressure area and the north side of a high pressure area.

Although airplanes capable of 3,000-mile flights were built during the 1920's and early 1930's, transatlantic crossings by air remained in the stunt class until the advent of the flying boats in the late 30's. The earlier planes could carry only fuel, and had to fly as direct a course as possible. This meant that a plane could not take off on a transoceanic flight until a day when the pressure pattern would furnish the greatest advantage in favorable winds. Scheduled flights could not be attempted until the range of the aircraft was increased sufficiently to provide a fuel capacity with sufficient margin to overcome unfavorable wind situations.

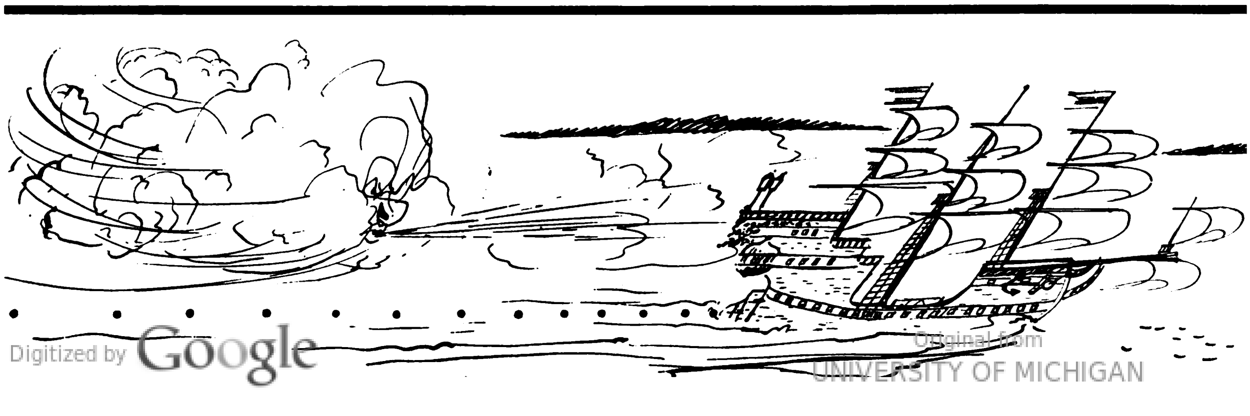
Meanwhile the airships, including the Graf Zeppelin and the Hindenburg, were operating with such success that transatlantic crossings between Europe and the United States, and between Europe and Brazil, became almost commonplace. Study of the methods of operation of these long-range craft indicates that the record they built up for safety, speed and comfort was due for the most part to expert use of the pressure patterns of the weather over the North and South Atlantic. Meteorological charts were maintained on board and constant reception of fresh reports from the continents and from ships at sea enabled the meteorologically-minded officers of the airships to avoid areas of squall and headwinds, and to direct their courses through areas where tailwinds could be found. At times the course from Germany to the United States would be by way of Greenland; at others, by way of the Azores. Most of the flights were operated at altitudes of 500 to 2,000 feet above sea level. At these altitudes, the winc average was greatest and could be used to th advantage.

An outstanding example of pressure patte was the crossing of the Pacific Ocean, from ' San Francisco, by the Graf Zeppelin during i the-world flight in 1929. Five days would h a good time for the crossing, but the airship in less than three because its commander and flew on the south side of a typhoon wl recurved and become an extra-tropical storn this boost over the expected "average" win North Pacific, the flight time was almost hal

In the late '30's, transportation by air a oceans became a matter of travel by heavier craft. The airships, with their great range, dous capacity for fuel and payload, and th fort and safety gained from taking adva weather conditions, fell into disfavor when denburg was destroyed by ignition of the d hydrogen used for lift. Airplanes, howeve it hard to include much payload because of reserve of fuel needed. It was necessary to rect a course as possible, because the rang aircraft was still relatively limited, and att maintain schedules emphasized the need and favorable weather conditions along th flight. Even now it is necessary, at times, departures because the winds en route at flyi would make it necessary to carry a prohibi load, or at times make it impossible to r intended destination.

With aircraft of greater range in use and p however, enough margin has appeared to m sible the regular application of pressure pa ing to scheduled operations. It was used on basis during the latter part of the war in th tion of flights between California and the I Islands.

The distance between the Islands and th land is 2,100–2,200 statute miles. This is we the range of aircraft used in the operation ever, the driving need to maintain schedule



rcraft to the fullest extent, and haul the largest ɔle payload on each flight made it very impor- :o make good time and haul as little fuel as ɔle. Leaving out the expected terminal weather tions, the main question was the pressure pat- between the Islands and the Mainland, and the on of the favorable and unfavorable wind sys- which result from the pattern. A difference of nots in the component wind would make a dif- ce of over an hour in flight time of an aircraft ı planned a trip of approximately twelve hours. : difference were favorable, more payload could rried in less time; if unfavorable, more fuel and were needed and less payload could be carried.

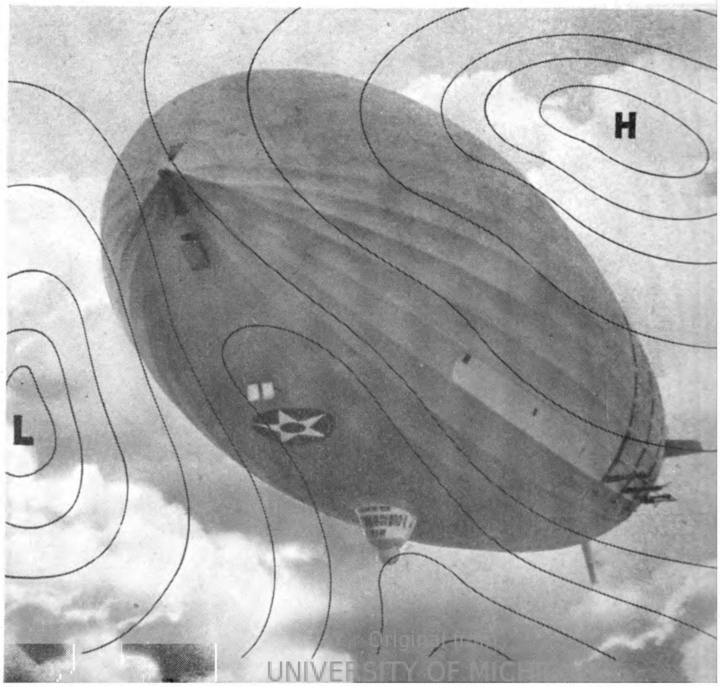
using the weather map, a flight path could be :d to take the most advantage of favorable winds discount as much as possible for unfavorable ;. The usual pressure pattern in the eastern ı Pacific Ocean is keyed by a cell of high pres- lying some distance off the coast of Lower Cali- ı. This cell oscillates northward and southward a mean position, and if its current location is n, its wind system and the approximate strength ıe winds can be figured by a meteorologist. ı the cell is far enough to the south, it will pro- winds from a westerly direction along the direct e between the Islands and the Mainland. When ; far enough to the north, there will be cross- ; along the direct course. By plotting a dog-leg e instead of a straight course at such times, the l flight time over the increased distance can be ;ht down below that needed for flight over the t course.

ıen the rough ratio of 10 percent of total load plus passengers plus cargo) per hour of opera- s considered, and when it is realized that up to :rcent or more of the payload may be involved, seen that the application of pressure pattern to a scheduled operation has an important and icial significance.

ɔm the trend of the times, it is definitely in the re that transoceanic planes, which are now oper- on a daily basis will use pressure pattern flying considerable extent in the future, to maintain ules. This means that aircraft will be flying the ıs and continents non-stop, not along definite w tracks between terminals, but over dog-leg or us courses within wide belts of air space. The search and rescue job in support of the flight operations will therefore be made tremendously more difficult, because of the greatly increased area to be covered. Although vessels for rescue purposes and navigational aids are now located along definite tracks, aircraft flying a pressure pattern course may at times be further away from such potential rescue facilities than from one or several land terminals.

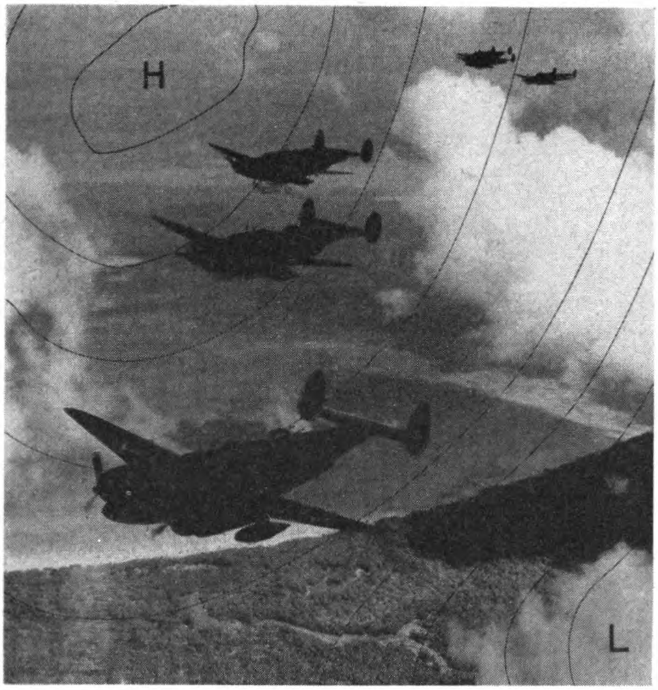
It is probable that a balance will have to be struck betweeen the benefits derived from pressure pattern flying and those apparent in being fairly close to search and rescue facilities in case of accident. Just as aircraft do not at present fly over the polar regions because they would be beyond reach of assistance if forced down, so will they condition their use of the navigable air space over oceans and continents to maintain the expectancy of safety and rescue provided by available navigation aids and search and rescue units.

The only other alternative, in support of the widest possible choice of flight courses related to the pressure pattern of the moment, would be to distribute the search and rescue units on a grid basis over the area to be flown, instead of on a linear basis along narrow routes. Financial considerations will probably make it impossible, at least for some time to come, to seek this solution. Military expediency would make such a program desirable, but its cost in support of commercial operations would probably exceed the gross income of the operations themselves.



Aerologation

The author of this article, Robert Mansfield, insisted that since many pers[…] responsible for the design and development of AEROLOGATION, credit shoul[…] centered on any one individual. In addition to Mr. Mansfield, who is Senior N[…] and Senior Navigation Instructor on TWA's International Division, the following[…] collaborated with him in the preparation of this material: Frederick Lambach, [...] oligist, Meteorology Instructor, Navigator, and Flight Superintendent at Gand[…] foundland for TWA International Division; Edward Bolton, Senior Navigator, Ch[…] gator, and assistant to the Manager of Operations, TWA International Division.



The term *aerologation* was suggested by Mr. Peter H. Redpath, of TWA, and seems best suited to describe the principles of this system of navigation. It is an attempt to plan, and work the flight by use of certain meteorological elements as measured in flight, and is, in effect, a combination of aerology and navigation. The radio and pressure (aneroid) altimeters are the instruments used to measure the pressure elements, and their use to guide the aircraft might be termed the science of navigation by altimetry.

The original work was done in the spring of 1945 by Fredrick Lambach, Edward Bolton and Robert Mansfield, of TWA, and was then tested by TWA, Intercontinental Division, while operating for the Air Transport Command. Further tests were n[…] Commander G. Wheelwright, of the U. S[…] Office of Research and Inventions, on seve[…] range flights made for the express purpose o[…] the value of altimetry for aerial navigation.

The principles of aerologation can be appli[…] equal success to over-land and over-water […] however, the procedures will vary. Many […] problems require a true altitude factor for th[…] tion, and at present there is no practical m[…] determining the exact true altitude of the […] when flying over land. The radio altimeter […] dicate this true altitude with considerable a[…] when operating over the sea, and the discuss[…] sented here is confined to the over-water op[…]

Aerial navigation is a rapidly expanding […] the practices that were adequate for short […] relatively slow aircraft are no longer vali[…] evolution of present day methods into a p[…] and efficient concept of aerial navigation […] quire major revisions of the principles no[…] but the change is inevitable. The princip[…] practices of aerologation have been tested, […] greater efficiency of operation proved, but i[…] the full answer to the problem. It is offere[…] attempt at correcting the faults of aerial nav[…] as we now know it, and is a step in the righ[…] tion. The theories of this system have caused […] deal of discussion among experienced navigat[…] meteorologists which have resulted in several […] in the procedures suggested in the first pa[…] the subject. Further discussion and resear[…] probably show better methods than are outlin[…]

The use of the radio and pressure (aneroi[…] meters for the determination of sea level p[…] flight level pressures and the drift angle of […]

, has been thoroughly tested and the reliability ɿults proved. By applying these measured values ıe elements to a few basic meteorological laws, ıtelligent analysis of existing weather conditions ssible. The value of such information is obvious ıy navigataor who has had to proceed for many ʒ during "instrument" conditions.

ıe in-flight determination of sea level and flight pressures provide a means for checking the ac- :y of the weather forecast. If the forecast pres- are considerably different from the measured ures, the forecast winds should be disregarded. discrepancy in pressures is indicative of an error eather map analysis and prognostication. Ex- nce has shown the computed sea level pressures : accurate; the error seldom exceeding five hun- ths of an inch of mercury (1.7 millibars). In ɔast meteorologists have been reluctant to accept computed pressures because they did not agree their weather maps. In most cases, it has been d that the weather maps rather than the com- d pressures were in error.

forecast weather map will show, with reasonable racy, the general picture and location of the ure areas. If the navigator obtains a sufficient ɔer of pressure readings, he can relocate the ure areas during flight, and from this current her map forecast winds and weather for the inder of the flight.

ıis ability to revise the weather map is by no ıs the most important feature of this analysis. It o possible to determine the drift of the aircraft ıg the preceding hours, and from this informa- to track or follow the aircraft when other naviga- l aids are not available.

ıe theory and procedures used in this problem ıot based on "black magic" but are a result of the cation of measured values to accepted laws of orology. We are indebted to Professor John C. my, of the University of Chicago, for the form- and without it the greater part of this proposed ogation would be impossible.

llamy's drift formula is derived from the geo- hic wind equation, and is based on the following:

a. direction of the geostrophic wind is parallel to the isobars.
b. force of the geostrophic wind is directly proportional to the pressure gradient (slope of the isobaric surface)
c. Buys–Ballot's Law: in the Northern Hemisphere, the low pressure area is to the left of an observer facing downwind. The reverse is true in the Southern Hemisphere.

From the above rules, it is obvious that wind direction will be at right angles to the pressure gradient, and by expanding this theory further, it is obvious that if it were possible to determine the pressure gradient in the direction of flight, we could then compute that component of the geostrophic wind which effects the aircraft at right angles to the heading. Figure 1 shows the relationship of this "cross wind" component to the total geostrophic wind.

This geostrophic component, normal to the heading of the aircraft, when combined with a parallel component which does not materially affect the drift angle, constitutes the total geostrophic wind. In the illustration; h, h_1, h_2, h_3, h_4, and h_5 represent isobars in an idealized pressure system. The pressure gradient, or fall of pressure per given distance, is to the right. By applying Buys–Ballot's law, and assuming that we are in the Northern Hemisphere, the wind direction must be south. A B represents the actual, or maximum, pressure gradient; and B G represents the total geostrophic wind. A D represents the direction of flight and is the measured pressure gradient. By applying the formula for geostrophic wind to this measured gradient we arrive at the resultant, D V, or the geostrophic component normal to the heading of the aircraft. D P is the component parallel to the heading, while D G is the total geostrophic wind.

Figure 2 shows the measurement of the pressure gradient, in the direction of flight. It is assumed that the height of the aircraft is being maintained by reference to the pressure altimeter; the aircraft would then be moving along an isobaric surface and the pressure altitude would remain constant, while the true altitude varied. The illustration shows an isobaric slope of 300 feet per 200 miles.

It is true that the actual wind is seldom geostrophic, and for that reason the drift formula is apparently inaccurate. Computation of the geostrophic wind assumes that the isobars are straight and parallel; curvature of the isobars introduces a cyclostrophic wind component which varies as the radii of curvature varies. In the case of pressure systems of small diameter, or low pressure trough and high pressure ridge points where the curvature is great, this cyclostrophic component can be large enough to make the computed drift angle inaccurate by several degrees. Pressure change also contributes an isallobaric wind component, which is large when the pressure is changing rapidly at a given point. Temperature differ-

ences, horizontally, cause the third error; wind shear, or thermal wind component. All of these components, when combined with the geostrophic wind, produce the total or actual wind above the friction zone; however, only in rare cases do these components become large enough to be considered in practical navigation. We are limited at present, by the fact that it is almost impossible to steer a desired heading any closer than two degrees, which makes the considera-

altimeter readings; if the true altitude is in while the pressure altitude remains constant, craft is headed toward higher pressures.

The suggested procedures for determir D_1 and D_2 values are as follows:

1. This method of drift determination sh be used at latitudes less than twenty degre the winds in these regions are not geostropl

2. The aircraft should be flown at appro

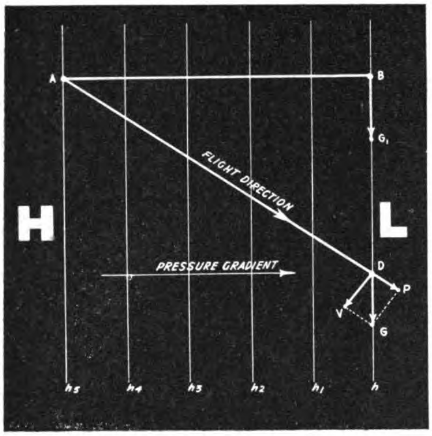


figure 1

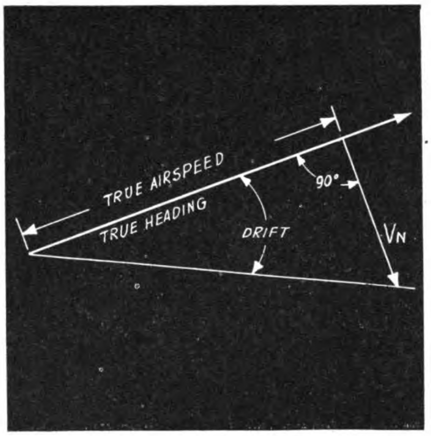


figure 2

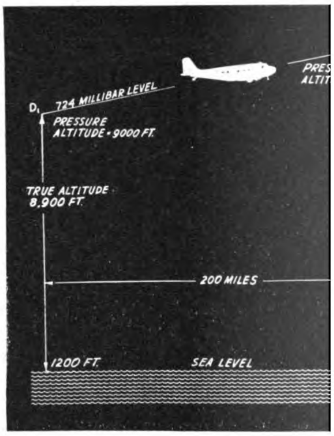


figure 3

tion of a fraction of a degree adjustment impractical.

The Bellamy drift formula is as follows:

$$V_n = K\frac{(D_2 - D_1)}{X} \qquad (1)$$

in which

$V_n=$ The geostrophic component at right angles to the heading of the aircraft, expressed in knots. This is a one hour value.

$K =$ A latitude constant and is equal to $\frac{21.47}{\text{sin Lat.}}$

$D_1=$ True altitude, as measured by the radio altimeter, MINUS the pressure altitude at the start of the run.

$D_2=$ True altitude MINUS pressure altitude at the end of the run.

$X =$ The air distance (no wind distance) in nautical miles between the D_1 and D_2 observations.

In the Northern Hemisphere, the sign of $(D_2 - D_1)$ is the sign of the drift *correction*. *By* reviewing the rules for circulation of air about pressure systems, the navigator will have an indication of the direction of drift. In the Northern Hemisphere, when headed toward areas of higher pressure, the wind will be from the right, and when headed for areas of lower pressures, from the left. This pressure trend can be determined by inspection of the radio and pressure

the same pressure altitude during the run observations. An altitude difference of 200 not cause any material error, but this shoulc sidered the maximum variance allowable.

3. The true heading of the aircraft sh change more than ten degrees during the ru smaller change is made, the V_n component applied to the mean heading.

4. The altimeter readings must be made w and the adjustment of the instruments checke reading. Although the height scale on the timeter is small, the true altitude should be the nearest ten feet. The observer must b that the altitude is not changing during the tion. Tap the pressure altimeter lightly, to the frictional lag of this instrument. *The r pressure altimeters should be read simultaneo* due to location of the instruments, this is not read the instruments as nearly simultan possible.

5. The time interval between observation not be less than twenty minutes.

The V_n component can be converted to angle by plotting vectorially, as in figure 3, c of the E6–B or similar D. R. computer. groundspeed is known, or can be estimated,

should be adjusted for the parallel component geostrophic wind. Figure 4 shows the differ- between drift angles computed from airspeed and those adjusted for the groundspeed.

nputed drift angles do provide the navigator a means for tracking the aircraft when other itional aids are not available, but this alone is ifficient for true navigation. Aimless wander- r "bracketing" of the desired track is not effi- navigation. Regardless of weather conditions, ivigator should lead the aircraft to destination. amy's drift formula can be used for the esti- of required drift correction to remain on If the navigator will construct a curve, by ig the $(D_2 - D_1)$ values observed against the of observation, as shown in figure 5, the curve be extrapolated ahead to the next hour, and $-D_1)$ value estimated with reasonable accuracy. possible that the extrapolated $(D_2 - D_1)$ value ot be true if the pressure system ahead of rcraft is small; however, by use of the revised er map, as mentioned earlier, the navigator can this extrapolated value. Although this pro- seems to involve a great deal of guess work, it easonable approach to the problem. To those is who might complain that these proposed ds require the navigator to be a meteorologist, ight point out the fact that successful aerial ition by any method requires a working knowl- of meteorology. There is no device at present ill eliminate the need for good judgment based eful analysis of the existing conditions.

tracking of the aircraft can be made more e by use of pressure lines of position (P. L.). These lines are determined by computing et effect of the wind up to the point in ques- The theory behind computation of the net of the wind is the same as the theory from the formula for the determination of V_n is d. Figure 6 shows the effect of the wind on an ft flying through an idealized pressure system. he flight is made from A to B, and the true ig is used as shown, it is obvious that the air- would end up on the heading line at point B, se the pressure at B is equal to the pressure at l the effect of the wind has been cancelled out; t isobaric slope is zero. In this case, the pres- ystem has been considered as being stationary. pressure area had been moving in the same on as the aircraft, the point at which the air- would arrive back on the heading line would

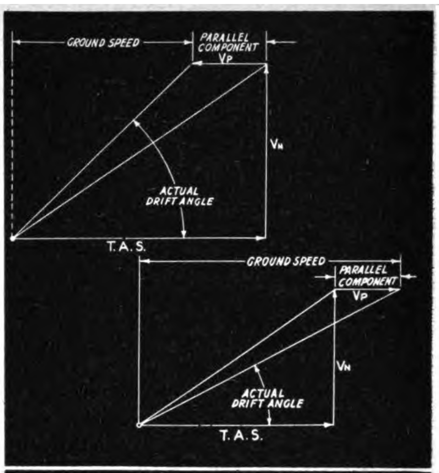


figure 4

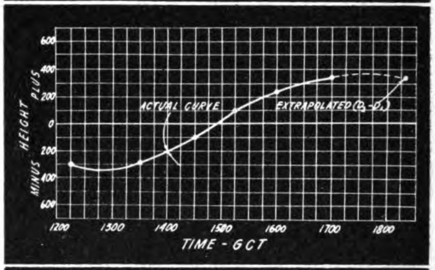


figure 5

figure 6

be some distance beyond B, depending on the speed of movement of the pressure system. Whenever the aircraft returned to the heading line, the pressure at that point would be the same as that of the point of departure; only if the pressure is the same, will the aircraft return to the heading line. In the Northern Hemisphere, if the pressure is less than the pressure at departure point, the aircraft would have to be to the right of the heading line, as in the case of the flight from A to C. If the pressure is greater, the aircraft must be to the left of the true heading line, as in the case of flight from A to D.

V_n, the component of the wind normal to the true heading, multiplied by the time involved would be the distance that the aircraft would drift from an airplot (no wind positions). It follows than, that if we denote the quality, V_n times time, as Z_n; that this Z_n can be computed from the same formula except that X, the air distance, becomes simply the true

airspeed. The mathematical derivation of Z_n is shown below.

$$V_n = K \frac{(D_2 - D_1)}{X} \qquad (1)$$

in which, X = true airspeed times time, or the air distance traveled.

then,

$$\text{Time times } V_n = K \frac{(D_2 - D_1)}{T.A.S.}$$

By stipulation, V_n times time will be donated as Z_n, then:

$$Z_n = K \frac{(D_2 - D_1)}{T.A.S.} \qquad (2)$$

V_n is independent of the groundspeed, because we are measuring the net change in the height of an

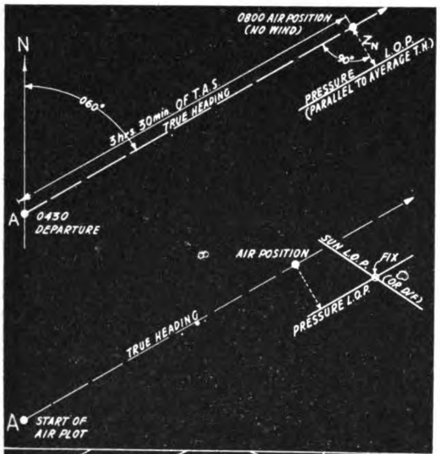


figure 7

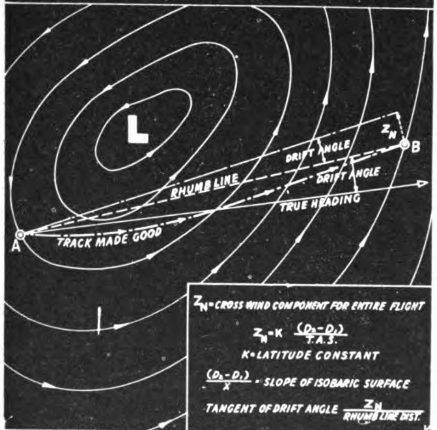


figure 8

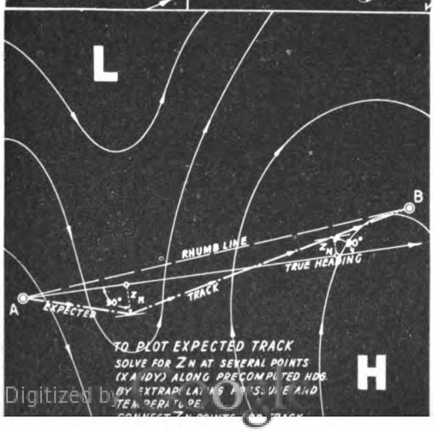


figure 9

isobaric surface; thus regardless of ground will be the distance normal to an airplot tha craft has drifted. Z_n, plotted vectorially airplot, indicates the distance the aircraft this airplot. If a line is drawn through th this Z_n vector parallel to the airplot, the r line of position. Figure 7 shows the pressu position (P. L. O. P.) and its relation to th

The pressure line of position has been u considerable success during the past year, an ence has shown this L. O. P. to be as accurat celestial lines. The expected accuracy of O. P. is three nautical miles. Obviously, sin basing the pressure line on an airplot, the P. will only be accurate when the airplot is The use of the Air Position Indicator (A. P make the problem easier to solve and the pressure line more accurate. In any case, w structing an airplot from observed airsp headings, or by use of the A. P. I., the airpl not be continued for more than three hours cumulation of errors will seriously affect the of the pressure line of position if carried an Thus a fresh airplot should be started from son or fixed position every three hours.

During daylight flights over routes where aids to navigation are limited, or are of poo the navigator has a means of determining tion of the aircraft at any time that a sun ob is possible. The intersection of a sun L. O. pressure L. O. P. will be an accurate fix.

The suggested procedure for determinatio P. L. O. P. is as follows:

1. Use the altitude difference at some "f as the D_1 value, and the altitude differenc time a pressure line is desired as the D_2 val

2. Compute and plot the airplot (no w tions) from the D_1 position.

3. Use the mid-latitude between D_1 and vations as the latitude for computation of constant.

4. Compute Z_n and plot the Z_n vector angles to the air position of the airplot a observation. If the aircraft has been heade a low pressure area, the Z_n vector is to be p the right (when in the Northern Hemisphe if headed toward a high pressure area, the plotted to the left of the air position.

5. Through the end of the Z_n vector, pl parallel to the mean true heading since the the airplot. This line is the P. L. O. P.

›st short range flight problems, such as search ›atrol flights, require the maintenance of a fixed and the flight time is of no great importance. ·adio altimeter is a valuable aid to the navigator :h flights, but the value of the instrument in the em of long range aerial transport is immeasur- The possible shortening of required flight time, the resultant fuel savings, is of prime importance s type of operation.

‹eral methods have been devised in an attempt to :n the flight time to destination, and all have some success. They have been based on the ıre pattern type of route selection, which con- of fitting the track of the flight around pres- areas to obtain the benefit of helping winds. navigator studies the upper air charts carefully letermines a composite course which will keep ircraft on the proper side of the pressure systems ve tail winds or to minimize head winds. The ›rologist then makes a wind forecast for this , and the flight is carried out by conventional ›ds of navigation. This pressure pattern method ›een used with considerable success, but it still ; a great deal to be desired. It is true that the ator can steer "off-course" to find tail winds, ınless this is kept within reason the added dis- will offset the gain in ground speed. Also, an urate forecast might give the navigator con- ıble distance to fly against head winds instead : expected tail winds. Too, unless the navigator ; many flight plans, based on as many different ination of routes, he will have no guarantee that ›ute he has selected is the most efficient.

e aerologation route which is described here ; to offer all the advantages of the pressure pat- :oute without the disadvantages. It is, in effect, ıtomatic pressure pattern route in which the of distance flown to the speed gain is optimum. : it is true that an aircraft on the great circle might make better ground speed while in the weather zone as the aircraft on the aerologation , this aerologation route will assure the best over- ›eed toward destination. The use of this aero- ion route also has a definite safety factor. The ›utation of a single, constant drift correction, ı is used, is not made from forecast winds; in the flight can be planned without any knowledge .e expected winds. This probably sounds like y to the many navigators who have had ex- nce with the North Atlantic crossing or other ns of intense weather and high winds, but this is not just a theory; the method has been tested and proved.

Probably the greatest fallacy of present day aerial navigation is the continued use of the great circle course, simply because it offers the shortest distance to destination. Experience gained from thousands of flights across the North Atlantic, has shown that the great circle track is seldom the best choice from either a weather or time standpoint. Operational records give proof that this "short distance" route can

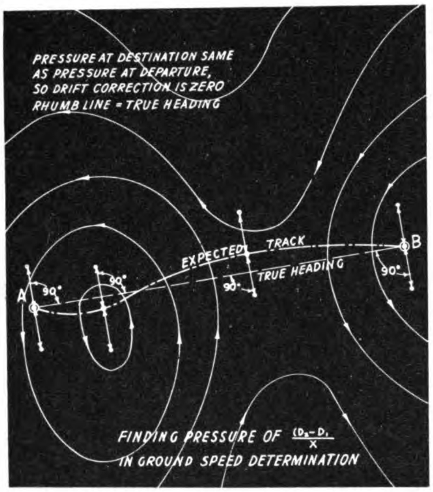


figure 10

require as much as four hours more than other routes to the same destination. Time differences as great as this are extreme; however, a time saving of fifteen minutes cannot be ignored.

The maintenance of a fixed track, such as the great circle or rhumb line, often requires large drift corrections with a resultant loss of ground speed. If the navigator were to apply a single average drift correction for the entire flight, the aircraft would then drift freely with the wind, and greater ground speeds be realized. It is true that the aircraft might drift as much as a hundred or more miles from the normal track, but the minimum correction has been applied and the aircraft will drift back towards the destination. The feeling that the aircraft is lost if it is more than ten miles from the fixed path has no foundation. Regardless of location, when making an ocean crossing, the aircraft is operating over the same kind of water, and the same navigational aids are usually available.

During the first years of scheduled over-ocean operation, several navigators used an average drift correction for the entire crossing with fair success. These single drift corrections were determined by averaging the drift corrections that appeared on the flight plan.

Since these corrections were computed from forecast winds, the flight would arrive at destination without further correction, only if the forecast winds were accurate. In most cases the navigator had to make several revisions of heading to make destination.

By applying what we now know of aerology and altimetry, the constant drift correction can be determined easily and accurately. If the drift over a past period can be computed from the slope of the isobaric surface, as measured in flight, it follows, then, that the drift ahead (drift correction) can be determined in the same manner if the net slope of the isobaric surface ahead can be found. The difference between the height of the slope at departure and at destination points would be the (D_2-D_1) value used in the formula. Z_n will be the net effect of the wind for the entire flight and can be converted to an angle which would be the minimum drift correction needed.

The formula used is the same as used for determination of the pressure line of position.

$$Z_n = K\frac{(D_2-D_1)}{T.\ A.\ S.} \tag{2}$$

in which,

Z_n = The net effect of the geostrophic wind normal to the straight line (rhumb line) path of the aircraft to the destination. This is expressed in nautical miles.

K = The latitude constant $\left(\frac{21.47}{\sin \text{Lat.}}\right)$ for the mid-latitude of the flight.

D_1 = The absolute height of the selected pressure level (isobaric surface) over the point of departure, forecast for the time of take-off.

D_2 = The absolute height of the same pressure level over the destination, forecast for the estimated time of arrival.

$T.A.S.$ = The mean true air speed expected for the flight.

The Z_n value can be converted to a drift correction angle graphically, by plotting the vectors in-

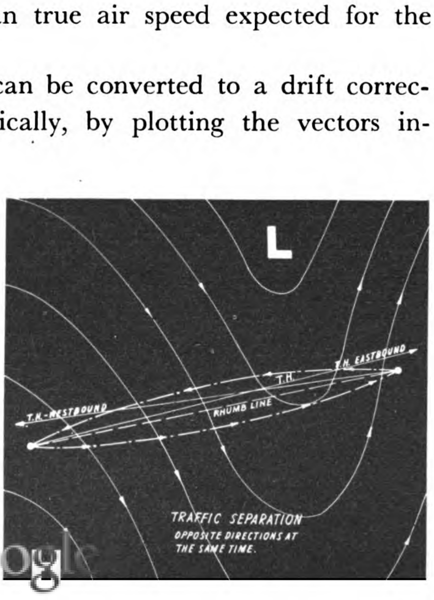
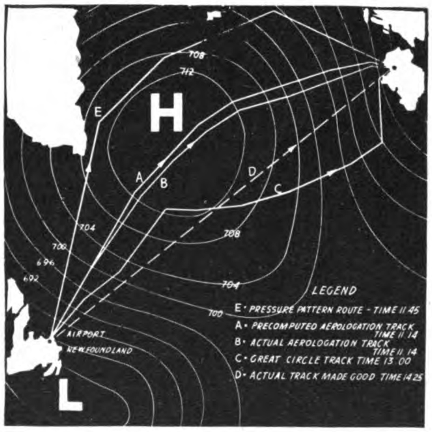


figure 11

volved, or mathematically by dividing Z_n
rhumb line distance which will result in the
of the drift correction angle. The problem
solved easily on most D. R. computers as an of
problem. The drift correction angle determ
these methods will not be exact, if the dis
greater than 600 miles. If the distance to
tion is greater than this, a small error will b
duced since plane trigonometry is being used
a spherical triangle. This error is negligibl
ever, since the angles involved are very small
small angles there is very little difference
plane and spherical triangles.

The direction of the drift correction angl
termined in the same manner as for the press
of position. If the height of the isobaric su
greater at destination than at departure, the n
is that of approaching a high pressure area.
Northern Hemisphere, the wind would be fr
right and the drift correction would be *plus.*
height at destination were lower than that a
ture, the net effect would be a wind from
and the drift correction would be *minus.* F
shows the aerologation route.

Here again, we are using forecast informa
the determination of a constant drift correctio
however, the use of just two forecast values, h
the isobaric surface at each end of the flight, in
the many forecast winds enroute, reduces the



fig

ity of error. Also, it is true that the height
pressure level can be determined with greater e
forecast with more accuracy than is possible w
tempting to forecast the winds.

The (D_2-D_1) value, as determined by th
method, requires the use of constant pressure
air charts. This type of chart is standard at
and is the easiest to use for this type of work. I
air charts are not available, the navigator or m

will have to extrapolate surface pressures to the ·ed flight level and then convert these flight level ıures to heights. This can be done with reason- accuracy by use of a pressure-height slide rule or h, but since it requires that temperatures be fore- as well as pressures, another source of error is in- ıced. The desired flight level will seldom coincide the upper air charts, and the navigator must inter- te the heights given by the various charts to his ted level. Careful interpolation is required if the t is to be made at altitudes above 10,000 feet.

rdinarily, the computed drift correction angle is ied to the rhumb line course and the navigator has nstant true heading for the entire route. The puted drift correction angle can be applied to the rate rhumb line chords that make up the great e course if desired. In both cases, the drift cor- ons used are constant. It is possible that under ıin circumstances the aircraft might be drifted areas of bad flying weather. This is the case n a low pressure area is located on course between ırture and destination and the aircraft is east- ıd. The best flying weather is found to the north ıe low pressure center, but the minimum drift cor- on would allow the aircraft to drift south into frontal zones. Time saving would have to be ificed in this case to avoid the poor flying weather, the flight would be planned to keep the aircraft h of the pressure center. To do this the navigator ld pick a turning point, north of the center, and for a constant correction to this point; then solve ınother constant correction from this point to the nation. This requires careful analysis of the syn- and forecast weather maps before planning the t, and a continuous check of existing weather con- ns during the flight in order to avoid serious her. As mentioned earlier, good judgment can- be replaced by any device or procedure.

uring the flight, the navigator must keep a con- t check on the sea level, or flight level pressure at destination. If the forecast height of the isobaric ıce appears to be in error, then an adjustment of constant drift correction angle is indicated. This ires the solution of a new problem from a known position to the destination. The navigator must ıpolate the radioed sea level pressure of destina- to his true altitude, and then convert this pressure his immediate flight level pressure to heights. A drift correction angle is then computed in the ıal manner and a new true heading flown. The navigator should obtain the sea level pressure and temperatures at surface and flight level from the destination every hour. These should be carefully compared to the forecast pressures to make certain that the forecast pressure will be accurate. If the navigator does his work carefully and seriously, the aircraft will be delivered to within a very small distance of the desired destination. The pilots must also work continually to hold the headings given by the navigator. Steering errors can put the aircraft many miles from the destination.

Tests made on more than one hundred flights using the constant drift correction, show that ninety percent of the flights arrived within fifteen miles of destination, and fifty percent of these flights were within ten miles of destination. When it is realized that the average distance flown was 1500 nautical miles, and that most of these flights were made by use of a single true heading, the safety value of the system is apparent.

In order to see the expected track and to determine the distance to be traversed on this aerologation route, it will be necessary to compute several Z_n vectors before the flight. For practical purposes, these Z_n values need be computed only for the wind shift points enroute. These wind shift points are located at low pressure troughs and high pressure ridges on the upper air charts. By plotting the Z_n vectors in the proper direction from the precomputed heading line and connecting these points with a line from departure through the end of the Z_n vectors and the destination, the expected track is shown. Figure 9 shows the determination of the expected track. A comparison of this track with the upper air charts will show whether or not the aircraft will drift into bad weather areas.

The theory of navigation by altimetry will be expanded still further to determine the expected groundspeeds enroute. This is the final step that makes the forecast winds unnecessary for flight planning.

Since it has been proved possible to compute V_n the cross wind component, by measuring the slope of the isobaric surface in the direction of flight, it should also be possible to determine the V_p component, which is parallel to the direction of flight, if the slope of the isobaric surface could be determined perpendicular to the heading.

This V_p component will be used in conjunction with one hour of the true airspeed, in order to determine one hour of groundspeed, so it will be necessary to measure the slope of the isobaric surface for a distance equivalent to the true airspeed. This can

be done on the upper air chart by spacing the dividers to a distance equal to true airspeed, placing the dividers across the expected track, perpendicular to the true heading, at the point in question. The divider points should be equidistant from the track. The heights of the pressure level are then read at the divider points and a $(D_2 - D_1)$ value found by obtaining the difference between the heights noted. It will be necessary to determine the mean slope between departure and wind shift point, or wind shift to wind shift point and wind shift to destination. Figure 10 shows the suggested method of determining the slope normal to the heading of the aircraft.

This computed V_p component is combined with the true airspeed and the result is expected groundspeed. If in the Northern Hemisphere, when the low pressure area is to the right of the track, the V_p component will be subtracted from the true airspeed, since Buys–Ballot's Law indicates that this is a head wind condition. If the low pressure area is to the left, V_p is to be added to the true airspeed since it is obviously a tail wind component.

The accuracy of the upper air chart used for this computation will govern the accuracy of the results. In checking thirty trans-Atlantic flights by this method and comparing computed flight time by this kind of groundspeed against the actual flight time, an average difference of eleven minutes was found. This compares favorably with flight plans computed in the conventional manner. Practically, the groundspeed need only be computed between wind shift points enroute. Two or three groundspeeds will suffice to compute flight time within a few minutes of the time determined in the usual manner.

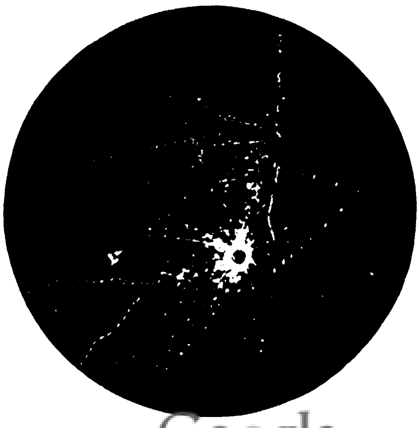
Another advantage of the aerologation route (single drift correction route) is apparent when the problem of traffic separation is considered. If all aircraft flying in opposite directions between two points are maintaining a great circle or rhumb line tr only separation possible is a vertical clearance. in adjusting the altimeter to the proper a setting might jeopardize the safety of several If, on the other hand, they are following heading track, a horizontal as well as a vertic ation is provided. Figure 11 shows how possible, while at the same time giving both the most desirable route. In this illustrati assumed that there is but one pressure system l departure and destination. If there were tv sure systems enroute, the paths of the aircraf coincide at just one point. Three pressure enroute would be indeed a rare case, but ev the paths would meet at only two points.

An excellent example of the usefulness of puted, single drift correction flight can be cit the experience of a flight crew operating o North Atlantic. Figure 12 shows the upper a with several tracks drawn.

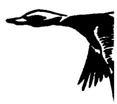
The flight departed from Newfoundland c appeared to be an entirely routine, but long Scotland. The weather map showed that pressure area was south of the course at both the flight, with an extensive high pressure ar the middle of the route, centered just north great circle course. Figure 12 shows the pressu at 10,000 feet, the average altitude of the fligh

The first few hours of the trip were une except for the strong southeasterly circulatior drifted the flight about 90 miles north of the course. The captain and navigator conferred point and decided to get back on their planne circle course, not realizing that the wind wou in the near future and drift them back on cou new heading was determined and the aircraft accordingly. About the same time, the wind

(*Continued on page 52*)



RADAR MYSTERY



Trans-Canada Air Lines' radar screen at Winnipeg picks up not only aircraft operating in Winnipeg's vicinity, but also geese and ducks. For a long time radar operators at TCA could not fathom the dots appearing on their screen. Too small for training aircraft, they were finally found to be birds migrating at 1,500 to 2,000 ft.

n Dwyer is the founder and president of Aerial ıcts, Inc., manufacturers of pyrotechnic equipment. ·f perusal of his background shows why—completely from business considerations—his interest in air ·scue comes naturally. He was a Naval aviator in l War I, being credited with the longest nonstop l flight of that war (9 hours, 37 minutes). One of ons, Martin, Jr., a B–17 pilot of the 8th Air Force, hot down over Germany and taken prisoner. The , Thomas J., is an Annapolis graduate, 1945, now ıg aboard a cruiser in the Pacific. Mr. Dwyer is ·cipient of the Naval Ordnance Development Award ıis research and development work in Naval ord- ·; is a founder of the Aviation Commandery, Naval · of the United States; member of the Wings Club; Birdmen; and Advisory Committee, New York State rtment of Labor for drafting the Industrial Code ng to explosives.

Pyrotechnics for ASR

ıring the war, pyrotechnics . . . described e science of burning fuels and compounds to pro- certain visual effects . . . developed into a ime industry, along with electronics, aeronautics, ɔther of the arts and sciences which were fulfilling ırgent wartime need. From a comparatively le business, commonly regarded as merely the uction and selling of fireworks, there has emerged ‹act and complex science producing a multiplicity roducts for many needs. The degree of per- ance perfection achieved under the most rigid of tests has been amazing. Yet, it was natural exceedingly high standards were necessary because an lives depended on it. In many instances, per- ıance failure would have meant loss of life.

'orld War I experiences proved that all methods of ılling were hazardous, and most times unreliable. phone lines were short-lived because of the intens- ıf artillery barrages. Trenches were too close to ıy lines to permit flag signalling. Messenger serv- vas costly in human lives, and telegraph was easily cted by special listening devices. Radio was an ı secret and subject to interception and jamming. s, pyrotechnics, in code, provided the logical ver and was the signalling medium resorted to by ı sides.

'hen the Armistice ended hostilities in 1918, pyro- nics manufacturers forsook their wartime roles and t back to their early trade of producing fireworks. The disarmament program, the belief that the "war to end all war" had been brought to a successful end, public reaction—all played a part in terminating further research and development of equipment which, at best, promised little of commercial value. It became again a business of supplying various noisemakers and bright-light displays for Fourth of July celebrations.

Thus, by 1939, only a handful of men in the country knew or cared much about pyrotechnics—either as a science or a business. A few flares, smoke bombs, land mines, rockets, and other items had been developed for military and naval use, but the volume of annual business did not warrant any large scale operational or production improvements to increase their effectiveness. Various types of pyrotechnic equipment were used in sham battles and maneuvers by the armed forces, but only under conditions dictated by the users. Thus, the need for 100 percent performance was not particularly imperative.

The Pearl Harbor disaster catapulted the Nation into a world-wide conflict, the proportions of which staggered even the imagination of our most experienced military commanders. Torrid jungles, icy polar regions, operations underseas and in rarefied atmospheres at high altitudes, all had an effect on general operations which posed many special problems and often rendered well-designed material useless.

Most of the development in pyrotechnics was held

Showing the pyrotechnic signalling kit made for the Navy for use on American flag vessels.

secret during the war, but the coming of VJ-day placed it in the "now it can be told" category. In the spring of 1942, the Navy's Bureau of Ordnance was engaged in collating masses of reports from the four corners of the world. All available data from the British, French, Chinese, and others was being classified, analyzed, clarified and distributed to field officers, many of whom were new at their jobs. Alarm and identification signals, formerly used on maneuvers, often proved totally inadequate in the conduct of modern, high-speed, high-powered war in which the merest fraction of a second, or some unforeseen condition, meant the difference between success or failure.

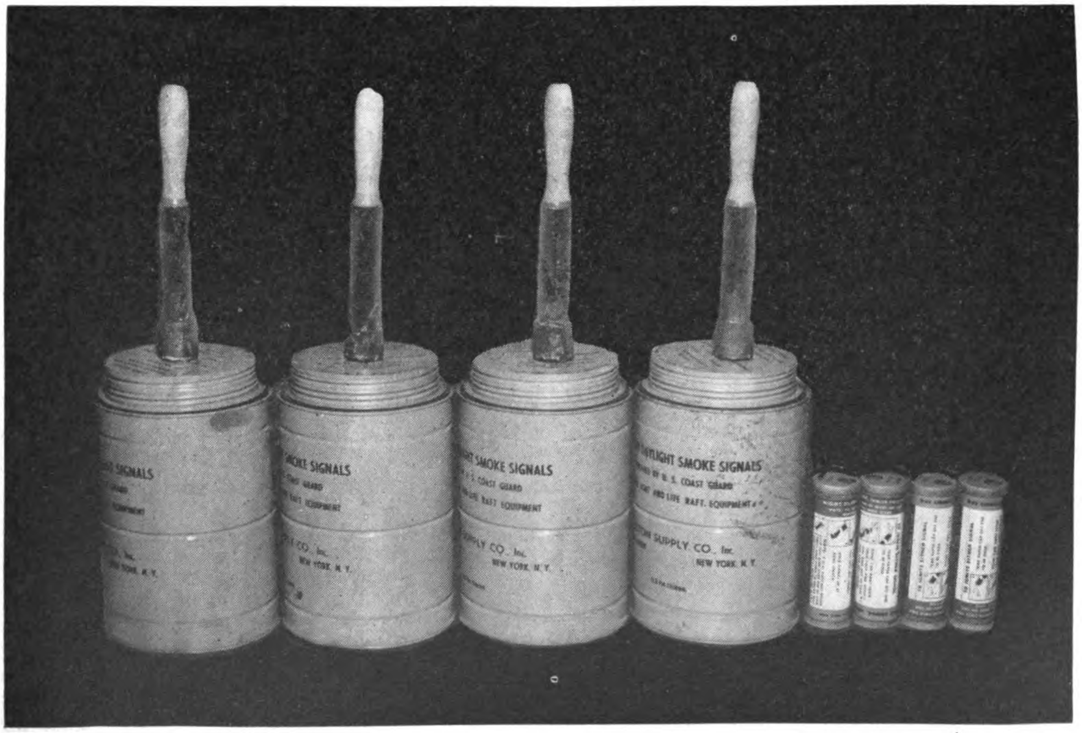
It might be well to review briefly some of the practices which existed in the pyrotechnic field in 1942. For years it had been a matter of providing aerial fireworks displays of 80 rockets, 80 flares, 80 of something else. The manufacturer would bring along his helper and about 120 rounds of the various types with him. If one failed to fire, he tossed it aside and took another. He regarded the fulfillment of his contract as satisfactory if he used 100 rounds to obtain 80 displays. But with the exacting specifications required for military and naval use, such standards of performance would, if continued, have cost many lives.

Pyrotechnic devices for air sea rescue then available included the Friction Ship Signal Light; Very Pistols and Signal Cartridges; a Parachute Flare which required the use of a 3½ pound pistol for projection to 150-foot altitudes, and a water light similar to the carbide lights used on bicycles at the turn of tury. No smoke signals had been approve sea rescue work. All were made to standards able to those developed for the fireworks outlir and were of the hit-or-miss variety. Thus a sl of such equipment had to be sufficient to allc average number of misfires, plus an allow spoilage due to improper handling.

Recognizing the needs of the times, a experienced individuals combined to consider lems of development, production and use. T ferred at length with military authorities, whom felt that more reliable rescue signallir ment for use on long overwater flights was im Currently available equipment, entirely desi use on ships, in lifeboats, or on rafts was too b heavy, and generally too unreliable to pro practical advantage to the aeronautical pictur

For example, the old-fashioned stick ro been in use for more than 100 years on merc sels. In a photograph accompanying this is shown ready for launching, and in compar a Pistol Rocket Signal Mark 3 Shower, w second operator is about to launch by mea Pyrotechnic Projector AN–M8. Although r nals of both types were made and used du war, the stick rocket had the following obv advantages:

(1) It was not absolutely moisture proof
(2) It required match ignition



At left orange-sı ing sign

(Top four stc minute type sec which aı tory equ U. S. vessels.

At right the Nav terpart, Day-Nigh 13 Mod.

'ark 2 Life Vest, designed by BuAir, Navy, showing
ark 13 Mod. 0 Day-Night Distress Signals which fit
e pockets of this vest as standard equipment.

The old-fashioned stick type distress rocket (left) with launching rack, and the A-P Pistol Rocket Shower Signal as made for the Navy for use on American flag vessels.

It required the long stick to guide it in flight
It required a launching trough
Because it was manufactured in multiples of 12, 24, or more, the loading pressures were so varied that rockets often delayed the discharge of their pellets until after they had passed the zenith of their propulsion, and were falling. Often the falling rocket ejected pellets within a few feet of the water.
The position of a launching trough is such that in a seaway, the roll of the ship may deflect the initial direction of the rocket so that it goes off the deck on an almost horizontal plane and crashes into the water before the delay train has a chance to expel the pellets, thus defeating the purpose of the signal.

: Navy wanted a Pistol Rocket Signal with posi- ;nition, a carefully balanced delay train so that :llets would discharge in shower at the zenith, ne that would afford the operator freedom to 1 any desired direction, regardless of the move- of the ship.

ocket encased in an extruded aluminum cart- with a standard primer was subsequently de- l to meet Navy requirements. Surrounding the llant tube is a series of four collapsible vanes spring out as the rocket leaves the projector. eration, these vanes act as does the tail vane bly on an aerial bomb which is guided in flight. By individually loading each rocket with progressive increments of propellant, compressed with uniform pressure, the time delay was made uniform and assurance provided that the pellets would eject at the zenith. The initial auxiliary powder discharge given the rocket causes it to rise about 30 feet before the propellant increments generate sufficient jet pressure to drive the rocket to the desired height, whether it be 500 or 1,500 feet.

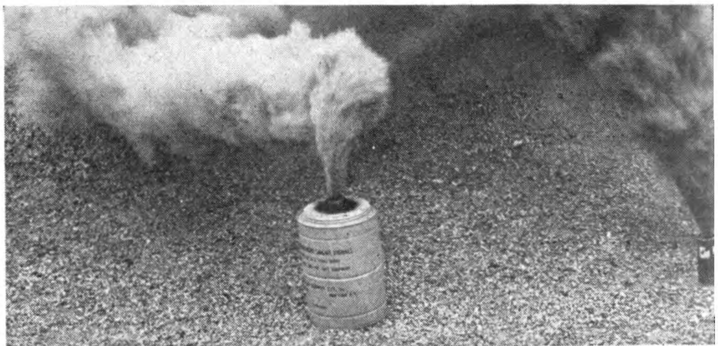
A number of these signals were submitted to the Navy for test, as a result of which a contract was issued to manufacture the A–P Pistol Rocket Signal Mark 3 Shower, and to pack them in a container holding 12 units, together with two Pyrotechnic Projectors AN–M8. This assembled pyrotechnic kit was designated Pyrotechnic Outfit Mark 2. It was made available for use on all ships under the American flag as a replacement for the old type stick rocket.

The Coast Guard had approved a large float smoke signal, but its size precluded the possibility of using it in aircraft. The signal was 9.4 inches high, 6.35 inches in diameter and weighed 5 pounds, 7 ounces. At this time also, the Navy was using Hand Grenade HC–M8, which emitted a greyish white smoke. Smaller and lighter than the smoke float signal, it nevertheless did not approach the standards sought for air sea rescue work. It contained pyrotechnic material, 35 percent of which was zinc dust, to produce the greyish white smoke. This made the loaded

grenade quite heavy. It also burned with considerable heat, rendering it useless as a hand smoke signal unless provided with a special holding tool. While this would add rather than detract from its disadvantages, it seemed the best starting point at the time. A folding wire holder was devised which fastened permanently to the bottom of the container and folded against the sides. For a short time it was used with some measure of success when no other signal was available. Like all other pyrotechnic equipment on hand at the time, little thought had been given in design to limit weight and displacement, or to make the container moisture-proof. It was but one of the many innovations used in the early part of 1942 to fill out the gap between design and the final development of adequate signalling devices.

scratcher would operate the igniter. When signal gave off a fair type of red light for 2 m

In actual use as an air sea rescue distr however, the friction ship signal frequently ignite. It was found that after several high altitudes the signal literally *breathed c* rarefied atmosphere and on descent it *brea* taking in both air and moisture. Obviou equipment was of little value as emergency unless new signals were installed at each The addition of the handle to the Hand HC–M8 for daytime use was still the best b too, contained the weakness of absorbing after several trips to high altitudes. Yellc was substituted to provide the signal with range of visibility, but we still had a long w



Note comparative size and volume of smoke emission between standard floating signal (left) used in lifeboats and liferafts of merchant vessels, and the A-P Distress Smoke Hand Signal AN Mark 1 Mod. 1.

Showing the comparison in flare brilliance between the standard 2-minute friction-type distress light (left) used on merchant vessels, and the Navy counterpart, the A-P Day-Night Mark 13 Mod. 0.

An example of the inadequacies of signals available at the time, is to be found in the ordinary friction ship signal which had been used for nearly a century aboard naval and merchant vessels. It consisted of a wooden handle, 5 inches long, to which was fastened a 4½-inch pyrotechnic candle. Over this candle a wooden cup was placed. The cup had the abrasive on its outer side similar to that on the ordinary safety match box. Every part of the signal except the part held in the hand was covered with waxed paper, taped in place to exclude moisture and the entire pyrotechnic end then taped in paraffin. To operate, a loose end of the wrapping tape was pulled off, the cup removed and reversed so the

For one thing, air sea rescue proved beyond that it is far more effective to set off intens high visibility signals for a shorter duration provide a longer burning low visibility sign

At about this time, an M–8 type Smoke S advertised in a flying magazine and in seve publications widely read in ward rooms, rea and training centers. So pointed was the that it was decided to concentrate on an en signal. It was decided that the new signal very small, and not require the use of a handle; that it must be entirely containe nited, and heat-insulated so that it could b the hand while burning; that it be he

at the factory and never opened unless used; ıat the pyrotechnic compound would continue n even though submerged.

the setting of these standards was easier said lone. It was found, for instance, that igniters of ll-wire type would be satisfactory if a way could ınd to assure some measure of positive ignition them. After months of experiment with vari-rms of adhesives, one was found that would hold rasives on the scratch-wire. Then it was found sudden jar set off a considerable number of new ; when the fulminating cup knocked against the ve. This was remedied by leaving the first three lengths in the scratch-wire bare of the phos-s so that the fulminating cup, if jarred, would ach that material and set off the signal.

antime a laboratory had been constructed and conceivable condition of atmosphere, pressure, rature, humidity, storage in vacuum and under sion was simulated. In the course of exhaustive t was found that the required standards of per-nce could not be achieved without the applica-f a strict system of quality control in all phases nufacture, from the raw material to the moment the unit was finally sealed for shipment.

war had proved that the old methods of loading iixing pyrotechnic compounds had to be revised. the time raw materials were delivered to the they were constantly sampled as they were proc-through the various stages of manufacture. their purity, moisture-content, and other factors be controlled.

er the bugs had been eliminated from this new gnal, a limited number were sent to each of the ry services for testing under field conditions. y thereafter, the signal was approved and 600,-f them ordered by the Bureau of Aeronautics ureau of Ordnance, U. S. Navy. It was desig-the Distress Smoke Hand Signal, Mark 1 Mod. 0. its adoption by the Army Air Forces, it received signation Distress Smoke Hand Signal AN-Mark d. 1. and the procurement was increased an ad-al 3,000,000 signals. At first, they were manu-ed at the rate of about 1,000 signals per day—a which had been gradually stepped up to 20,000 ay at the conclusion of hostilities. Inasmuch as gnal would continue to burn under water after n, and because failures were practically non-ıt, they are known to have saved the lives of of our airmen who were forced down far from their carriers and bases in the oceans where the real war-time air sea rescues were effected. This signal was considered adequate for specific needs, and ef-forts were then concentrated on the development of other type of equipment.

By the end of 1944, while it was realized that all airmen were seeking the best in air sea rescue signalling equipment, it was acknowledged that few improve-ments had been made in night flares. The friction ship signal had long since been discarded for the rea-sons outlined in this article. To insure proper mois-ture-proofing, the Navy made up distress signal kits in a sealed can containing 24 signal cartridges, and adopted the Hand Projector Mark 4 to replace the Very Pistol formerly used with them. This kit, while more or less adequate at the time, had the disadvantage of deteriorating once it had been opened.

The Air Sea Rescue, the Naval Air Forces, the Army Air Forces, and the Royal Air Force all realized the deficiency of the night signals then being issued for use on aircraft. The Royal Air Force designed their T–49, a 2-star signal which operated on the principle of the Roman Candle. Upon ignition, it ejected the first star, after a few seconds delay, to an altitude of about 150 feet, followed by a second star which went to 250 feet. However, both star ejections from the candle produced considerable recoil. This same type signal was later redesigned by the Army Air Forces and produced as the M–75. Among its disadvantages was its lack of dependability after being subjected to a vacuum of 10 inches of mercury and then immersion in water for 12 hours. The Bouchon-type igniter was complicated, and it was found that rescue ships and aircraft had far more difficulty getting a quick position fix on a moving star signal than on fixed flares.

Development was begun on a new type of night signal, built to the general specifications of the Dis-tress Hand Signal AN-Mark 1 Mod. 1. It was agreed that if such a signal could be produced for use without the need of a pistol projector or separate holding device—either of which could be lost over-board to render the signals useless—and, like the day signal, be self-contained and individually sealed, a great step forward would have been made. Standard equipment at the time was the Distress Smoke Hand Signal AN-Mark 1 Mod. 1 for daytime use, and the M–75 two-star signal for night use. When it was requested that the two units be combined into one it

(Continued on Page 51)

new ship's transfer chair

The Knoxville Transfer Chair—safer, more comfortable, with a quick-release belt for speed in donning and removal.

A newpaper picture of Admiral Mitscher being rescued by way of an elaborate, improvised chair, provided officers and men of the U. S. S. *Knoxville* (PF–64) with the basic idea for the development of what may be an improvement over the old breeches buoy, and provide greater protection for men and a speedier transfer from one ship to another in the open sea.

The need for such an improvement was emphasized to the originators last December on two occassions when it was necessary to transfer the medical officer aboard the *Knoxville* to ships at sea which had personnel aboard who were in need of emergency medical assistance.

On December 18 the *Paiute* radioed the *Knoxville* that a crew member was suffering from acute appendicitis. The two ships rendezvoused but due to darkness and rough seas the transfer of personnel took several hours to complete.

Two days later the S. S. *Frederick Victory* requested the services of a qualified surgeon. A 20–30 knot wind and a night transfer, although successful, again involved several precious hours.

The two incidents sparked the idea for what has been affectionately dubbed the *Knoxville Personnel Transfer Chair,* in an attempt to make open sea transfer both safer and speedier. Using the idea of the as depicted in the picture of Admiral Mits crew started with a bucket seat from a di helicopter. It was already equipped with a lease safety belt. A padded kapok cushion m a life jacket was added to increase comfort a give buoyancy. The suspension bars which r the seat for further protection are made fron denum steel; the same as that used in airc struction. The chair is swung from the sam as the breeches buoy. Completely equipped 20½ pounds or the exact weight of the breeches buoy.

The conventional breeches-buoy method of transf ficult and time-consuming affair to get in and out

The inventors of the Knoxville chair clain advantages over the old type equipment. Inj sonnel can be strapped in with greater com safety and the quick release belt makes for donning and removal.

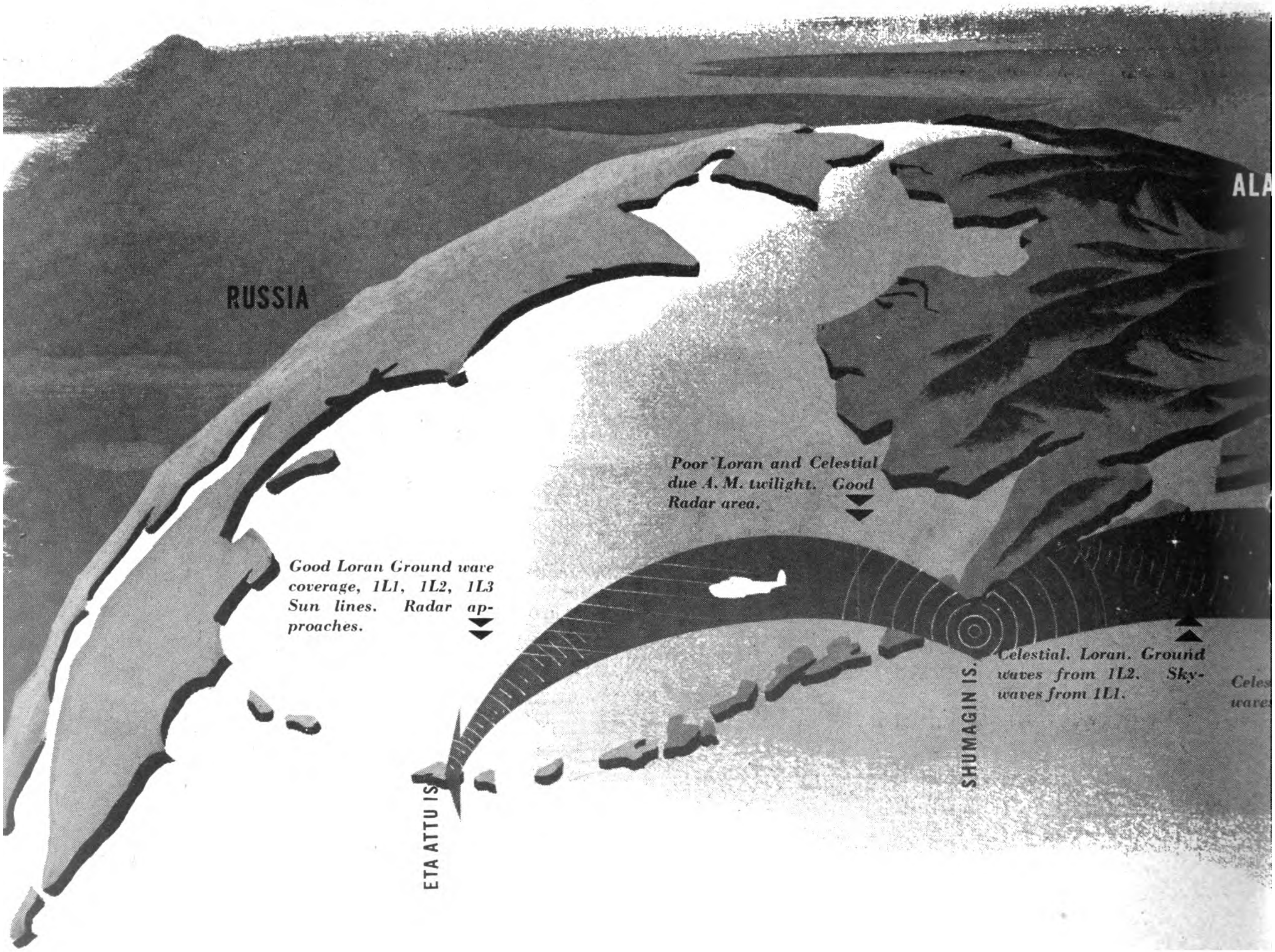
The originators of the chair recommend person being transferred wear an exposure su life jacket to provide protection in case the tossed in heavy seas. If either ship pitches there is the possibility that slackened ropes the rider a dip in the ocean. In this case th cushion will give the necessary buoyancy to k afloat. On a recent test the chair held its p and four men holding onto its suspension bars

The inventors make no claim that the chai than the breeches buoy if the two ships involv transfer are suddenly tossed close together i seas; but they do claim that the passenger h greater chance of getting free by simply unsnap quick release belt than he would of ridding hi a breeches buoy that has to be cut away.

The Knoxville transfer chair has not yet b cially tested under hazardous conditions at sea *Knoxville* crew plan to continue to impr test it during their future patrol duty.

ımmander W. F. Catlett, USN, graduated from the l Academy in 1932 and, before the war, served for years as an air navigation instructor at Pensacola Corpus Christi. During the war he served extensive of duty in the Philippines and Australia. Since 1943, he has been directly responsible for the op-ɔnal research and development of the Navy's far-; air navigation training program, and is one of the regular naval officers designated as Naval Aviation rver (Navigation). He is a member of the National cil, Institute of Navigation . . . Lieut. Comdr. . Coutts, USNR, is the only Naval Aviation Ob-r (Navigation) to graduate with honors from the l Air Force Empire Navigation School, Shawbury, ınd. He has been an invaluable contributor to the rch and development of navigational aids, systems, ıavigators during the war. He is a member of the ute of Navigation and expects soon to resume his ing profession in California where he is principal llbrook High School.

Long Range Navigation

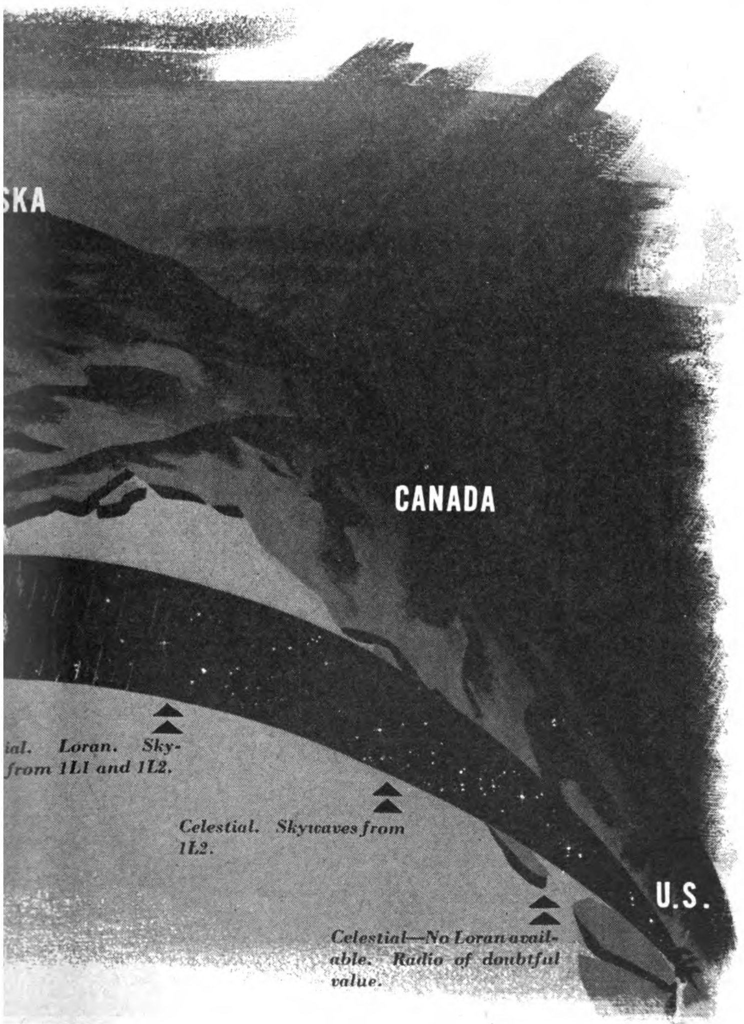


FOREWORD

The pressure of war time navigation is off. A more leisurely, and it is hoped a more thorough, approach may be made to the art of long range navigation. The authors have attempted in this article to integrate a few of the many aids available and systems now in existance for air navigation and to show how they may be intelligently used for long range operations. The speed of aircraft may be expected to increase in the future along with the range, at the same geometrical proportions they have in the past decade. The art of AIR NAVIGATION will be played much like a musician, an accomplished musician, first slowly in three quarter time, gradually building up speed of movement, action, integration to the split-thirty second timing of the air age symphony. Herewith is an air age flight study.

I THE PROBLEM

This flight is from NAS Whidbey Island, to NAS ATTU. The purpose of the flight is to carry the



maximum amount of supplies to Attu. Th
used will be a PBY–2 with radome installed, bı
out armament. The flight will be conductec
conditions of maximum range. Fuel loading
limited to the maximum consistant with the s
duct of the flight. Computation of fuel neeı
be based upon a gross weight at take off of
pounds. The net weight of the aircraft,
crew, but with all operational gear aboard,
taken as 38,000 pounds. Take-off will be
GCT, 16 March 1946. A crew of seven will l

II PRE-FLIGHT CONSIDERATIONS:

Subsequent to receiving operational orders
flight, and prior to take-off, there are a nuı
definite tasks which it is the responsibility
navigator to complete:

(1) Analysis of the weather
(2) Selection of charts
(3) Choice of publications
(4) Selection of route
(5) Analysis of navigation methods aı available
(6) Preparation of flight plan
(7) Preparation of fuel analysis and prel howgozit curve.

In addition to these tasks it is of course n
that the navigator assume responsibility for see
all navigational gear needed for the flight is
and in good working order.

Let us assume that the information presente
"The Problem" is in the hands of the na
that he has approximately 2 hours before take
see how he should proceed in order to most ef
perform his preflight duties.

ANALYSIS OF WEATHER

Much of the pre-flight planning is depende
the information received from the aerologist, a
await completion until his forecast is receive
the other hand, the vertical cross section and t
cast winds aloft will depend upon the naı
choice of route, and cannot be prepared by the
gist until after a conference with the navigator
liaison between the navigator and the aero
essential for efficient flight planning. In cer
stances tactical considerations will predeterı
route to be flown. In these cases the ae
can prepare all of the necessary informatio
out conference with the navigator. It is sti

however, that close liaison be maintained. It ly in this way that the aerologist will become iar with the problems of the navigator, to the ual betterment of data supplied by him.

e weather map indicates that a high pressure centered over Alaska, dominates the entire re- of the flight. Winds along the southern portion s high will, in general, be easterly, and will pro- a strong tail component for the flight in ques- The front indicated on the map should not rapidly enough to reach ATTU before termina- of the flight. No weather should be encountered than that associated with a polar air mass. At des above the clouds no icing is to be expected. st any route chosen by the navigator will be e, and his choice of route can be based upon s other than weather.

CTION OF CHARTS

art selection goes beyond the mere gathering up ew plotting sheets prior to take-off. The navi- can relieve himself of a great deal of inflight by spending a few minutes selecting and pre- g the proper charts prior to boarding the plane. any cases, judicious cutting and pasting together arts will greatly expedite their use in the air.

ne method of selection of the necessary charts d be adopted. The following method is sug- l:

Indexes of Charts: The Hydrographic Office cations No. 1–V (R), Index to Aviation Charts Publications, and No. 1–L, Catalog of Loran s and Service Areas, are of primary importance se chart selection. These may be supplemented her indexes, if desired. They will, however, h the navigator with adequate information on pes of charts and publications available for any ular area.

Charts Used for Flight Planning: Flight plan- will ordinarily entail choice of route, selection analysis of navigational aids, and selection of ates. For the flight in question a number of s were used for planning purposes.

Charts Used in Flight: Charts to be used in will depend upon the type of navigation to be availability of navigation aids, and to some ex- upon the personal preferences of the navigator. choice of charts must await completion of the sis of navigation aids.

Charts for Alternate Bases: Choice of alter- bases demands that charts showing details of available airports be used. While the small scale charts used for navigation plotting show many airports, knowledge of best approach, facilities available, etc., is best obtained from a relatively large scale chart. This information may best be obtained from the chartlets in Naval Air Pilots, or from special approach charts. The charts used on this flight were taken from Naval Air Pilot No. 301 for the Aleutian area, and supplemented with AAF Flight Charts.

(5) Special Navigation Charts: Choice of special navigation charts must also await analysis of the navigation to be used. On this flight the charts chosen were for three purposes: Loran, radar, and radio facilities. For Loran, VL–30–9, G–8–N and G–9–N were used. For radar, fairly adequate charts are provided by the AAF. Radio information is also provided by these flight charts.

CHOICE OF PUBLICATIONS

In addition to charts there are certain publications with which a navigator should be thoroughly familiar. Among these are: Naval Air Pilot, Aircraft Facility Directory, H. O. Light List, Radio Navigational Aids, Radio Weather Aids, and the Racon List (H. O. 520). Information regarding these publications is contained in the H. O. Index to Aviation Charts and Publications, H. O. No. 1–V (R).

No Aircraft Facility Directory has been published for the Aleutian area. Naval Air Pilot, NAP 301, was selected for use for this flight, and the necessary pages removed for use in flight. Essential information as to airport facilities enroute is found here, as well as data on approach at destination. The H. O. Light List for the Aleutians and the Racon List were also selected.

SELECTION OF ROUTE

As mentioned above, the weather map shows a synoptic situation which permits the navigator considerable latitude in the selection of route. Assuming that the weather is uniform over the area, choice of route may be based upon navigation aids available, alternates, and upon minimum distance.

The planning chart shows three tentative routes: (1) Rhumb line, as obtained by joining departure point and destination on a Mercator chart, (2) great circle, as obtained by joining departure point and destination on the Lambert Conformal, and (3) a modified great circle course consisting of two rhumb lines, whose vertex is a point near the vertex of the great circle course.

The third route listed was the one selected for use. This route has several advantages over the other two. First, it is shorter than the rhumb line course. Second, it does not involve numerous changes of heading as does the "true" great circle course. Third, it passes over better radar targets and thru better Loran coverage than does either of the other two. Lastly, it affords more alternate airports enroute.

The use of the Lambert Conformal in the determination of a great circle route is not, of course, exact. Two other methods could be used: computation, or transfer of points from a gnomonic projection. Neither of these two latter methods is practical, however. Computation is time consuming, and the availability of gnomonic projections when needed is notoriously poor. For air purposes, it has been found that the lack of accuracy entailed in the use of a Lambert for this purpose is more than compensated for by the time saved.

ANALYSIS OF NAVIGATION AIDS TO BE USED

The planning chart shows the Navigator's analysis of the navigation methods and aids enroute. The procedure of preparing such an analysis is highly desirable, as the navigator may refer to this chart in flight, thus saving valuable time in determining the best aid to use in a particular area.

Analysis of navigation aids and methods to be used is based upon (1) route chosen, (2) aids available, (3) time of departure and arrival, (4) conditions enroute. Take off for this flight was set at 2315 PST, 15 March 1946. Analysis of celestial navigation begins with the computation of the time of sunrise and the beginning of morning twilight enroute. This computation need not be exact, calculation of the time of sunrise at the turning point being sufficient.

After computing the time of morning twilight and thus getting an idea of the duration of time during which celestial observations will be useful, the navigator must determine some method of navigation to be used during the twilight period when neither sun nor stars are available. The planning chart offers two possibilities—radar and Loran. Loran is known to be affected by twilight, particularly when using sky waves. The middle portion of the flight, however, offers excellent opportunity for the use of radar; the numerous islands and well-defined coast lines are ideal for this type of navigation.

Loran coverage information is obtained from H. O. 1–L, Catalog of Loran Charts and Service Areas. The coverage chartlets for the Aleutians sh reception may be expected as shown on the p chart. Poor cuts during the period of optimu tial navigation and good cuts and fixes dur daylight portion of the flight may be expecte

This same publication also contains other im data. The correction chartlets for the various pairs to be used are included in the back of th The navigator should plot his expected route c correction chartlets, and make notations on th to be used for plotting so that he will remei make the necessary corrections. This is of pa importance where Loran is to be used for purposes.

PREPARATION OF FLIGHT PLAN

In modern long range practice, the flight prepared in conjunction with the flight time a and the howgozit curve. As a very approxim liminary, the ETE is usually computed on tl of the known average true air speed of the Thus, in this flight an approximation of tl could be obtained by dividing the distance miles, by the estimated average TAS, 165 kn ing 14 hours and 35 minutes as the ETE. Tl exact computation will be discussed below.

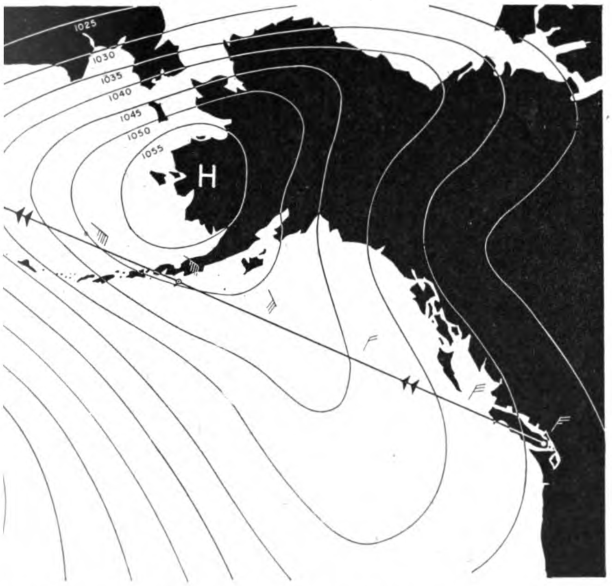
PREPARATION OF FUEL ANALYSIS A PRELIMINARY HOWGOZIT CURVE

The first essential in the preparation of analysis is the possession of tested fuel consu and power setting data for the aircraft to b The Pilot's Handbook will usually provide a data. This information, however, should b checked and modified for the particular airpla which it is to be used. Variations in engir departures from the exact aerodynamic contou plane caused by modifications in the plane's ment, and lack of attention to the proper fl titude will cause serious departures from tl given in the Pilot's Handbook.

The flight information for the PB4Y–2 is g tabular form. This form is probably the easi quickest to use, although for those who prefe same data are presented in graphic form. Th tion of a column after the "Gallons per Hour" c headed "Bracket Time Interval" (BTI), will e the construction of the howgozit curve. BTI i the time interval to burn the fuel increment l the tables, and is arrived at by dividing the crement (5,000 pounds) by the gallons per hou

 the particular gross weight in question. For ›le, at 60,000 pounds gross weight, the gallons ›ur listed for maximum range operation at 10,- ›et pressure altitude is 220 GPH. Assuming a ıdex of 5.89 pounds per gallon, the BTI is found ›iding 5,000 pounds (the fuel increment) by the ct of 220 gallons and 5.89 pounds. The result- ΓI is found to be 3.86 hours. The black line on ›wgozit curve is plotted by using the BTI column, ınce being made in the first time interval for el used in warm up, take off, and climb to flight ıde.

› flight time analysis is self-explanatory. The ›s. Time section and the Distance vs. Time sec- ›ere filled in concurrently. Fuel zones and aerol- ›nes did not coincide exactly, and the navigator to keep them separate. Practically as good re-



er map of flight area. Note high and low pressure allowing considerable latitude in route selection.

›ould have been attained by taking an average over the fuel zones, thus eliminating the addi- computations entailed in separate fuel and er zones. A description of the first two lines of ınalysis will suffice to explain the procedure.

›erring to the Fuel vs. Time section, the first line ›ained from the Four-Engine Take-Off, Climb ›anding Chart. Entering the Climb Data sec- ›ith 65,000 pounds, the gross weight at take off, ›ith 10,000 feet pressure altitude, the selected level, it is found that 230 gallons of fuel will be the time to level off will be 16.0 minutes, the best ›ted air speed will be 128 knots, and the recom- ›d rate of climb is 450 feet per minute. All of this data should be noted for the later information of the pilot. The 230 gallons of fuel is converted into pounds (1,355 pounds) and entered in the fuel used column.

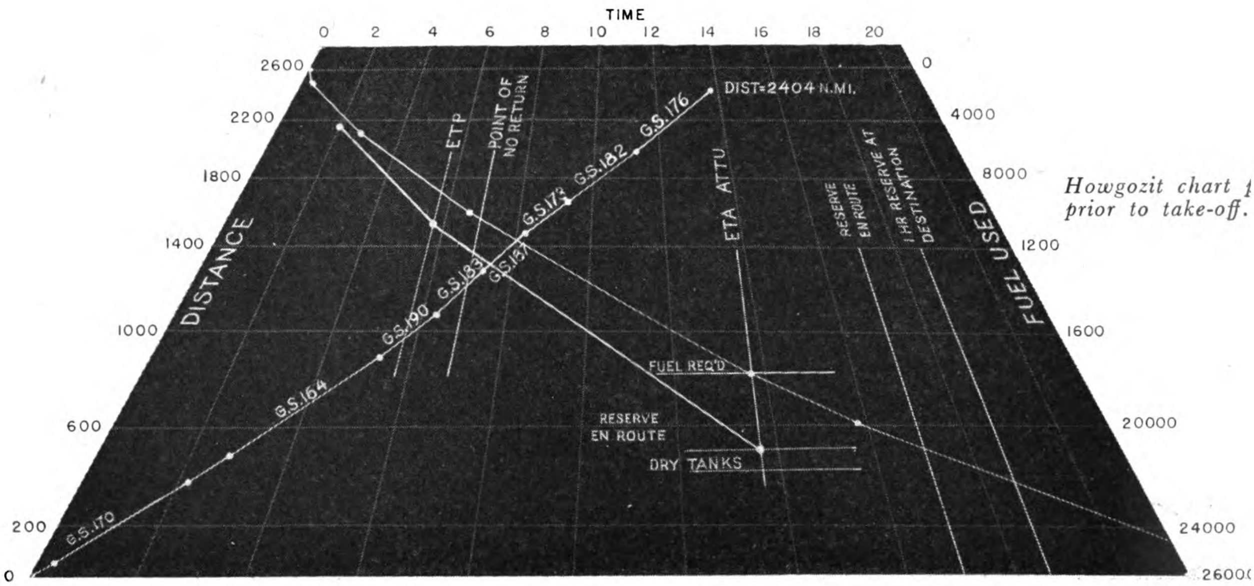
The IAS given is converted to TAS on the basis of forecast temperatures, and with the forecast wind, is entered in the first line of the Distance vs. Time section. The remainder of this line is filled in, the distance to level off being obtained. The Distance vs. Time section serves as an excellent flight plan. An additional column may be added, if desired, for the recording of true headings.

The fuel used to level off is subtracted from the 5,000 pounds of the first fuel increment. The remainder, 3,645 pounds, is the fuel to be burned before a gross weight of 60,000 pounds is reached. The data for this fuel increment are obtained from the Flight Operation Instruction Chart for Gross Weight 65,000 to 60,000 pounds. Referring to this chart, column V, under Maximum Air Range, 10,000 feet Pressure Altitude, it is seen that the data given is as follows: RPM 2150, MP 32.0, mixture AL, GPH 247, TAS 165 knots. The GPH is converted to pounds per hour, using the same fuel index of 5.89. The resulting pounds per hour, 1,457, then is divided into the remaining fuel increment in the first zone to give 2.56 hours, the remaining time in the first fuel zone.

On the second line of the Distance vs. Time section, using the forecast wind and the recommended TAS, the distance flown during this 2.51 hours is found. This distance is laid off on the chart, it being seen that power settings will have to be altered at this point. The new power settings are taken from the Flight Operation Instruction Chart for Gross Weight 60,000 to 55,000 pounds, the data being entered and computed in the next line of the Fuel vs. Time and Distance vs. Time sections respectively.

For Distance vs. Time Data returning, similar procedure is used. The data are calculated from the end of the zone nearest mid-point to starting point, assuming that the same winds will exist. This calculation is based upon four-engine operation, there being little difference in economy between three- and four-engine operation in the modern four engine aircraft.

After the Fuel and Distance sections are filled out, the distance to the equi-time point and to the Point of No Return are calculated by formula. The Point of No Return must fall beyond the Equi-time Point for the flight to be possible. This is accomplished by



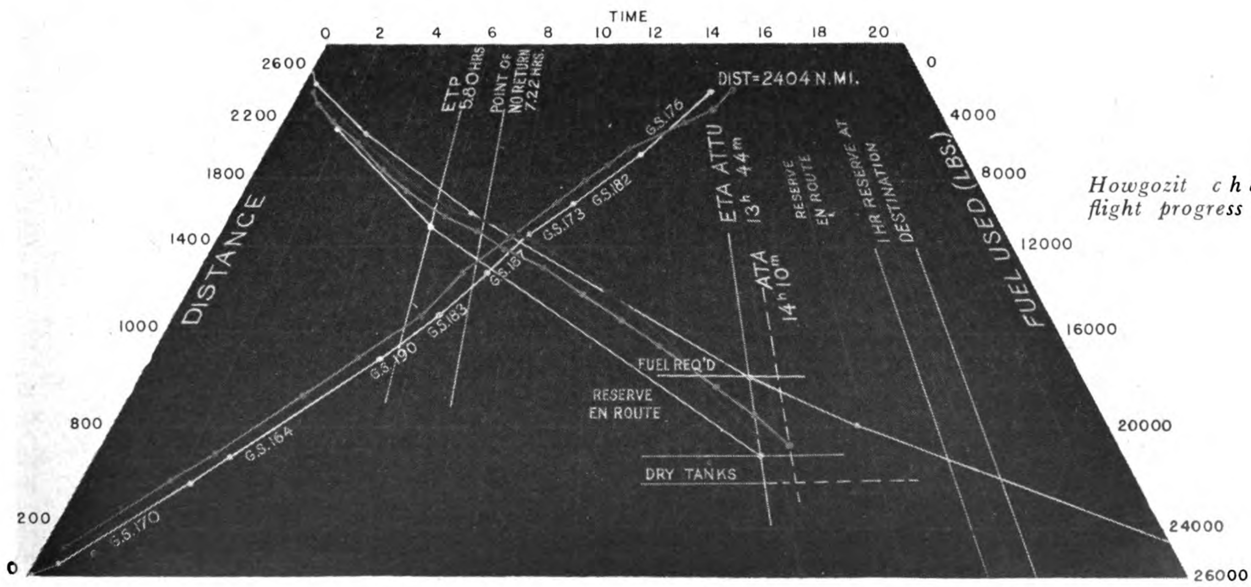
Howgozit chart
prior to take-off.

the correct calculation of reserve fuel, as explained later.

Calculation of reserve should be based upon the conditions which are expected to prevail. The forecast for this flight indicates that winds giving strong tail components are expected throughout most of the flight. This is the worst possible situation should it be necessary to turn around and return to departure point. It is bad also if the winds should turn out to be less strong than anticipated or should the direction radically change, as then the time taken to continue to destination would be greater than predicted. It was decided to allow for a large error in forecast, and to allow 20 percent excess over the fuel needed for the flight. This, with one hour's reserve for holding over destination, should provide the desired margin of safety. On this basis, with fuel needed enroute plus total reserve, the fuel to be loaded am to 3,900 gallons, or the maximum fuel load 1 type of plane.

Computation of available pay load was base the net weight of the aircraft as given, plus the of the crew and of fuel loaded. This, allowin crew of seven, total weight 1,400 pounds, am to 62,400 pounds. The net pay load, therefo 2,600 pounds.

Preflight preparation includes the preli drawing up of the howgozit curve. The bla the red danger line, equi-time point, Point Return, reserve lines, and the predicted groun lines were drawn in. The remaining lines, bl green were drawn in flight, and will be di later.



Howgozit char
flight progress in

IN-FLIGHT NAVIGATION

ɜ flight duties of the navigator go far beyond the ractice of measuring the course, applying the ɪst wind, and giving the pilot a heading to fly. ıg range operations, where fuel consumption is ɔortance, it is the duty of the navigator to keep rcraft as close to the desired course as possible times. To do this he must provide himself up-to-the minute information as to the wind ıg. This, in turn, necessitates taking advantage ɜry possible aid to navigation, plus the use of ıent which can only be based upon long practice. this flight, the navigation practiced could well ɪ out before hand. The time of departure and ɪisting Loran coverage made celestial navigation practical and necessary over most of the first ɔf the flight. For a short time after take-off, aids were available, and were taken advantage the navigator to secure a fix at level off—always ɪd procedure. From the time that the Van- r coast line was passed until nearly the mid- of the flight celestial navigation was used, a fix obtained at least once per hour. Celestial ɾations were also used to check the compass ion on all major headings.

ɜddition to the standard procedures of celestial lead reckoning navigation, the navigator took tage of the radar and pressure altimeters to ob- ltimetry drifts. The altimetry track is shown on otting charts as a green line. The accuracy of ı track depends upon an accurate knowledge of d speed. This the navigator had available, due number of celestial observations which he ob- .. The altimetry track was used in this flight ɾ as a check upon the drifts as obtained between It can be readily seen that had fixes not been ble during the first part of the flight, the altimetry vould have been invaluable, no other means of ıing drift being possible.

l checking at regular intervals was regularly On the plotting chart 100-mile intervals from ture point to destination were marked off as a of facilitating plotting of fuel-fixes. In this ɜr it was a simple matter to calculate the dis- ahead or behind forecast at any time during ght. Information received from the flight en- was recorded in the log, the amount of fuel ın gallons and pounds being noted. This in- tion provided the data on which the blue line ɜ howgozit curve was based. The green line ased upon the distance ahead or behind forecast at any particular fuel fix. It will be noted that in the early part of the flight, the blue line approaches very closely to the red danger line. Inasmuch as the plane was ahead of the forecast distance, however, the green line leads the blue one, and is well within the reserve area. This indicates that the flight is safe to continue.

In the later portions of the flight, however, due to winds which varied in both force and direction from those forecast, the fuel fixes show the plane to be behind schedule. The green line now falls to the left of the blue line. The flight is continued, however, as the green line is still well above the red danger line.

The middle portion of the flight, that part which passes over or near islands and coastlines, was navigated by means of the APS–15 radar. Little comment is needed on this type of navigation, it being essentially map-reading. It will be noticed, however, that radar navigation is greatly facilitated by the use of appropriate charts. The AAF strip charts are of a scale which permits the easy identification of scope pictures.

Loran was used during the first part of the flight more or less as a check on the celestial observations. The area between the west coast of the United States and the Aleutians is one in which Loran is not at its best. The reception for the first 300 miles of the flight is poor, due to the fact that this area is on the extreme edge of the sky wave coverage of station pairs. The next few hundred miles provide better reception but poor cuts between lines, making the obtaining of a good fix dependent upon very exact readings—difficult to obtain with sky waves unless conditions are good. After passing the end of the Alaskan Peninsula, however both reception and cuts improve, with the added advantage of having a third station pair, 160, as a check for fixes. Added speed in the first part of this flight upset the navigator's calculations as to the time of morning twilight, so that celestial was used longer than anticipated. As can be seen from the charts and logs, Loran furnished an easy and reliable means of navigation after sunrise and during the difficult period during which the sun was too low to shoot.

IV POST-FLIGHT ANALYSIS:

An all too common tendency exists to forget about operational difficulties encountered with navigational equipment in flight after the flight is successfully completed. Maintenance sections, operational requirements agencies, briefing officers, and aerology sections, however, must base their activities upon information

received from navigators as to the operation and efficiency of the equipment and material supplied them. The filling out of an analysis sheet subsequent to the completion of a flight is the easiest means of getting this information to cognizant agencies. Information supplied in this manner will inevitably result in the betterment of both operational efficiency of instruments and navigational aids, and of the pre-flight data supplied the navigator.

V *TRAINING REQUIREMENTS:*

To all appearances this problem may seem to be an actual flight study from Washington, across the gulf of Alaska to the Aleutians. It was flown in a combination of four trainers, integrated together at NAS Quonset Point. It could have been flown at any one of the following air stations—Coco Solo, Canal Zone, Key West, Fla., Norfolk, Virginia, New York, San Diego, Alamed, NAS Whidbey Island, Kanaohe, or any of the air stations of the training command where multiengine training facilities include the modern training devices. Similar problems may and have been flown over the North Atlantic areas; Army navigators have been trained on flights over the north pole in the trainers. Training and research may be done concurrently for polar navigation development without the expenditure of planes, fuel or lives until the crews are ready and have developed satisfactory skills in the art of integrated navigation to navigate to the four corners of the earth. The Navy's $60,000,000 investment in navigation trainers can be put to a good economic use in peace time (provided instructors and operators are trained or retained in the Navy).

Wartime developments in the field of air navigation have been such that the air navigator is often confronted with methods and equipment which are beyond his ability to utilize to the fullest extent. This lack is not due to a want of desire on his part to take advantage of every possible navigation aid, nor is it any reflection upon his professional standing that he is unable to do so. *Lack of adequate integrated training is the primary reason for lack of proficiency.*

In the Celestial Navigation Class Trainer (CNCT), and to a somewhat lesser degree in the Link Celestial Navigation Trainer (LCNT), there is provided an ideal means for furnishing this integrated training. When used in conjunction with the Radar Ultrasonic Trainer, the Loran Supersonic Trainer, and the Altimetry Trainer, and with the proper use of automatic drift simulating equipment, terrain projectors, and automatic radio compasses, the CNCT offers a plete an array of navigational equipment as found in the most modern aircraft. All methods of air navigation can be used under i tor-controlled conditions. Flights can be con on the ground in such a manner that those m best suited to a particular mission or to a specif graphical area are correctly used and integrat a navigational whole.

Those phases of air navigation which are p conducted on the ground—pre-flight briefing, planning, weather analysis, and post-flight de ing, can be added to the conditions available CNCT to make up a problem which differs fr actual operational mission only in that it is con under conditions which are controllable. The provides a realistic and efficient means by whi time usually lost during foul weather conditi the operational or training squadron can be ga employed. The squadron commander is affo means of checking out his pilots and navigators all of the conditions which they are lik encounter.

The accompanying problem represents an a to demonstrate the training possibilities of a equipped CNCT. This problem was actuall formed in the trainer. The charts and logs re the results obtained.

VI *CHOICE OF A SAMPLE PROBLEM*

Choice of a flight which demonstrates all navigational applications of the trainer and adheres to sound operational practices invo number of problems, some of which are here

(1) The flight should be of sufficient durat make flight planning, calculation of fuel reserv the keeping of a howgozit curve a necessity.

(2) The area chosen for the flight should in which unique navigational problems are lil occur.

(3) Loran ground and sky wave coverage exist over part of the area.

(4) Celestial navigation should be necessa about one-half of the flight. Navigation b sights at night and by sun lines in the dayt desirable.

(5) Choice of route and of destination sho such that radar can be used for fixes and appr at least part of the time.

(6) Racon coverage should be considered.

(7) Radio aids should be considered.

) A synoptic situation should prevail which per- use of celestial navigation, pressure pattern navi- n, and the keeping of an altimetry track.

) The latitude limitations of the present CNCT d be considered.

e area chosen, that between the west coast of Jnited States and the Aleutian Islands, answers of the qualifications set forth above. An ex- d flight from NAS WHIDBEY ISLAND to U, while probably not commonly undertaken in tional practice, is feasible, and provides sufficient ıce and time to make fuel loading and fuel con- tion of great importance, even in the very long PB4Y–2. Loran coverage is available, and in varying degrees of quality—the cuts and ıble reception being very poor in the eastern on of the flight, becoming very good as the mid- is passed. The large number of islands in the ians makes radar navigation practical. Suffi- radio facilities are available to allow as much of radio aids as desired. By referring to the her Supplement to the Naval Air Pilot for that a synoptic situation was found which was ideal oth celestial navigation and altimetry. The area ally suited to the operational characteristics of NCT.

APPENDIX I

RUCTIONS TO THE NAVIGATOR: (To be to the navigator two hours prior to the start of ight in the trainer.)

Obtain from the Aerological Officer the weather and forecast for the area of the flight.

Prepare a complete flight plan, using the follow- uestions as a guide:

a. Basing your decision upon the weather map upplied, over what region of the flight will favorable winds be encountered? What will be the approximate direction and force of these winds?

b. What charts will you select for preliminary flight planning? Where will you look for information as to charts available?

c. What charts will you use for navigational plotting in flight? Considering the type of navigation you expect to employ, what is the minimum number you will need for plotting, and what are they?

d. Where can information be obtained as to facilities at alternate airports enroute? What charts will you use to determine this information?

e. What special navigation charts will be needed? For what purposes will they be used?

f. If the pilot were to ask you for immediate information as to the location and best approach to any airport along the route, or at destination, what publication would supply you with the necessary data?

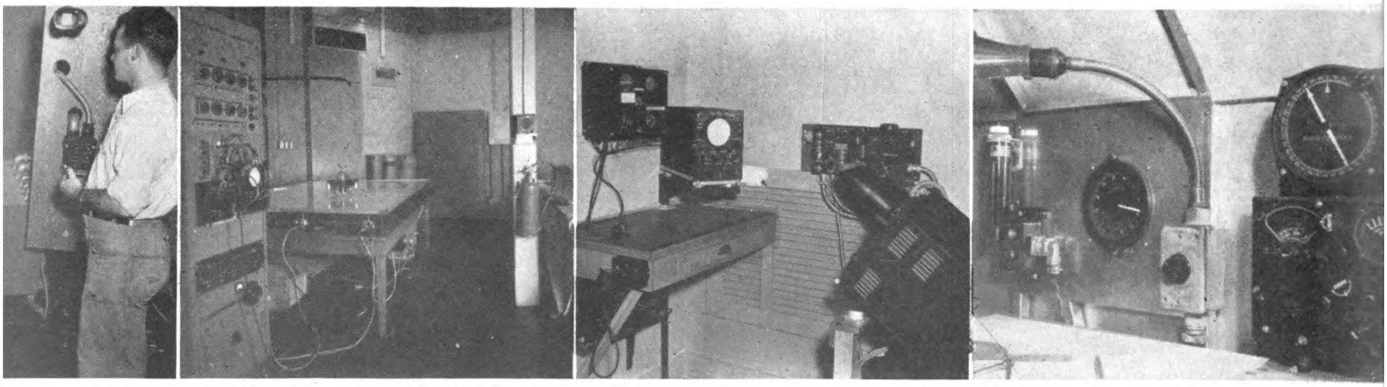
g. What other publications would be of use to you on this flight?

h. What is the shortest possible distance from departure point to destination? What is the rhumb line course and distance? Are there any advantages to a compromise between these two?

i. Having selected a route with due consideration for distance, weather conditions, and availability of alternates, consult the Aerological Officer regarding a vertical cross section of the route, and request a forecast of winds and temperatures aloft.

j. On the planning chart selected, lay off the course selected, and analyze the navigation methods and aids to be used over various portions of the flight.

k. If Loran is to be used, what additional in-



) R.: Lead Navigator's Station in CNCT: the Ultrasonic Trainer; the Loran Supersonic Trainer; Navigator's Station.

formation will be required for accurate plotting of Loran lines of position?

l. What is the preliminary ETE?

m. Compute the Bracket Time Intervals to accompany the information presented in the Flight Operation Instruction Sheets for the PB4Y–2.

n. Construct a preliminary howgozit curve based upon the BIT's computed above. Complete the Fuel vs. Time and Distance vs. Time sections of the flight plan.

o. What is the distance to the equi-time point and to the Point of No Return? What reserve is necessary to make the latter point fall a favorable distance beyond the equi-time point?

p. What factors should be considered in calculating the reserve to be carried? In view of the predicted wind situation, is minimum or maximum estimate of reserve to be recommended? Why?

q. Complete the preliminary construction of the howgozit. Show the predicted ground speeds, the danger line, reserve lines, etc.

r. What is the maximum amount of pay ar bomb load which can be taken on this flight?

3. After take off you will have all possible na tion facilities available. Navigate the flight these facilities in a reasonable manner. Keep a plete log, using the appropriate forms for cel and Loran observations. You will be expected form the pilot of necessary changes in power se and air speeds to maintain maximum range o tion. Decision as to the continuance of the flig equi-time point will be made by you. An altit track is to be kept at all times. Fuel data w obtained from the flight engineer. The radio o tor will provide you with radio bearings at request. You will provide the radio operator an hourly position report.

4. Upon completion of the flight you will b pected to fill in and complete the Navigation . ysis Sheet. You will be debriefed by the Opera Officer at destination.

5. The Aircraft Weather Report is to be maint at all times in flight.

(*Distress Frequencies—Continued from page 4*)

is believed, too, that, signals received slightly off frequency would not be missed if this adapter is added to present HF receivers.

HF/DF offers an emergency method for "fixing the position" of aircraft on long range flights. A network of HF/DF stations would be entirely adequate for servicing world-wide airways. For the present, equipment such as the SCR–291 is useable providing the mechanical bearing indicator is replaced by indicator kit MC–551; and for the immediate future, the AN/CRD–2 should prove adequate. However, the ultimate in serviceable, efficient equipment would appear to be a dual-channel type of instantaneous direction finder with a "dot lock" feature incorporated to reduce fading and bearing swing.

In conclusion, it is recommended that a prc be developed which would permit the HF/DI tem to be peaked for its primary purpose of g ing a standardized international high frequency tress band . . . and that all aircraft be requir carry a completely automatic transmitter such as previously discussed in this article. It shoul possible to put this transmitter into immediate o tion by turning on the emergency switch. This ation would be to radio what IFF is to radar.

It is further recommended that an internat VHF emergency frequency be standardized to in the development of a miniature transmitte radar beacon, such as the AN/CRN–16 AN/CPN–16. As this program is developed, al craft should be required to carry these units as s ard life raft equipment.

jg) Sidney Margolis H (S) USNR, with a civilian ground of uniform designing, is attached to the Medical Research Institute, Bethesda, Md. ig his term of service with Personal Equipment in facility of the Institute he has worked on rous articles of equipment: the continuous wear sure suit (ASR Bulletin, January); flak suit; aid kits; rain-exposure suit for shipboard wear; and rmored suit for fuze stripping.

• Exposure Suits

ie problem of protecting men from the effects of ersion in cold water has been the subject of much tigation by the armed services. It has been ly shown that immersion of men in water of C. or below is physiologically hazardous even for vely short periods of time, and that proper anti-sure protective clothing can be provided through nedium of watertight coverall suits.

iation requirements were largely met by the de-and adoption of a "quick donning" suit for air-personnel and a "continuous wear" suit for er pilots in single seat aircraft, but the problem lapting their use to shipboard personnel has not adequately solved.

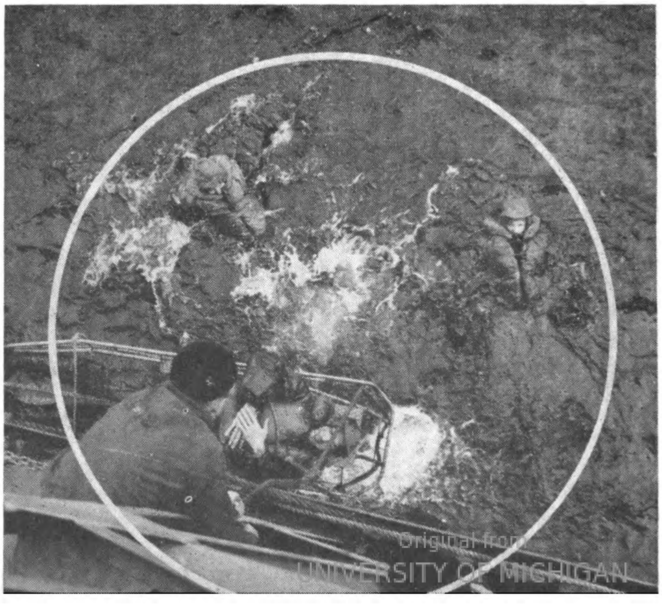
ie effectiveness of shipboard exposure suits in enting or retarding the dangerous effects of im-ion of men compelled to abandon their ship has dy been proved by continued years of usage in Norwegian Merchant Marine. But though such have been developed for use in the Navy and t Guard, objections have been continually raised h have precluded their widespread application most important of these have been (*a*) the suits too cumbersome for men to execute their pri-shipboard duties efficiently, and (*b*) the stowage em was insurmountable because space was at a ium. The conclusion has always been drawn such suits issued purely as adjunctive gear, could be justified in view of the diversified types of lard clothing already supplied, and problems of ng any additional gear.

overcome these objections, the Naval Medical arch Institute, Bethesda, Md., in co-operation the Equipment Design Section, Bureau of Ships, oped the proposed suit for topside personnel rd vessels operating in cold waters, to serve the dual function of saving life in the event of ship aban-donment and to replace some of the single-purpose rain clothing now supplied.

The proposed suit, while designed primarily for ex-posure, will also give equivalent or superior wind, spray and rain protection. It can be worn continuously and thus protect the occasional personnel who are washed overboard. It will afford protection to topside watch standers exposed, and to personnel during all "over the side" operations such as rescue drills, abandon ship drills, breeches buoy transfers, etc., where dangers of immersion are ever-present.

To ascertain the practicability and acceptability of a shipboard exposure suit (combination rain suit-ex-posure suit) and to explore the possibility of replacing some of the standard foul weather or rain clothing, the Bureau of Ships assigned observers to the U. S. S. *Knoxville* (PF–64) for the purpose of a field trial of 25 suits during an air sea rescue and weather patrol.

In view of the nature of the *Knoxville's* operations



on the North Atlantic sea and air lane, and because of its small size, the ship was specifically suited to the purposes of a field trial of protective cold water clothing. Its position "on station" was Air Sea Rescue and Weather Station Four at 51°45′ N. and 35°30′ W. For 20 days of the test period, the ship was within a 10-mile square whose center was the geographical position assigned to the station.

The observers designated for the field trial were Comdr. G. R. Reynolds, USCG, commanding officer of the U. S. S. *Knoxville,* reporting for the Office of Research and Development, Coast Guard Headquarters; First Lt. F. J. Hahn, AUS, for the Office of the Quartermaster General; and Lt. (jg) Sidney Margolis, USNR, for the Naval Medical Research Institute.

Although the object and interest of the observers was in the trial of the exposure suit as a continuous

wear shipboard foul weather garment, regularly practiced drills for "rescue of survivors" afforded an opportunity for "over the side" tests and demonstrations. Five "rescues" were performed during the test period with subjects remaining in the water (about 40° F.) for thirty or forty minutes at a time. Wearing the suit, they acted both as "survivors" and "swimmers" in manual rescues up the cargo nets and in the recovery of "unconscious" or "injured" survivors by means of the Stokes stretcher.

Other exercises, such as the fire drill and gun drills were performed to determine whether the suit would impede the movements of personnel to such an extent as to restrict or obviate its use.

The three watch-standing officers aboard th wore the suit on exposed bridge watches for eigh a day; the seventeen enlisted subjects wore it as lookouts and messengers on the bridge, in the and on deck in performance of their daily tasks.

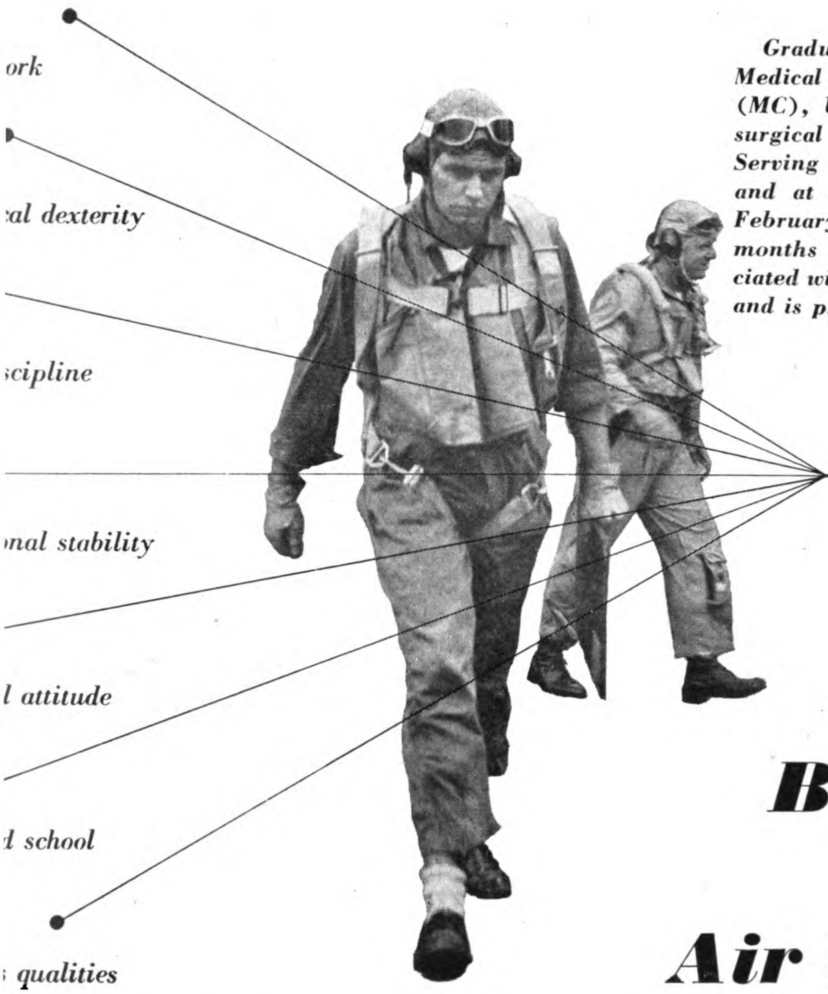
Summed up briefly, results of the field tria satisfactory. Performance of the suit in the wat good with little leakage and practically no con as to cold. On shipboard, the suit was prefe standard rain clothing and subjects wore it volu through foul weather even after completion trial. Observers agreed that it would replace t suit if temperatures did not reach tropical o tropical levels, and it would be especially tageous in the North Atlantic and North Pa

Certain features were undesirable if the suit to be subjected to routine shipboard wear an

have been taken to procure a more satisfactory rial and to remedy certain of the manufacturing comings which were readily apparent.

The value of a field trial of clothing and relat cannot be overestimated. Comparative evalua over-all performance of the suit and detection o nesses that will escape notice even under c controlled conditions in the laboratory, and the tunity to use a larger and more experienced g men, are some of the very real advanages. quacies in either the design of a suit or the fab other materials used in its manufacture can b readily detected, and suggestions as to modi or improvement carry more weight as a result stringent conditions imposed by a field trial.

Graduating from Northwestern University Medical School in 1938, Lt. Comdr. R. C. Hovde (MC), USN, served 4 years in post-graduate surgical training before entering the Navy. Serving in various medical assignments ashore and at sea, he entered aviation medicine in February 1943, becoming a flight surgeon 6 months later. He has been intimately associated with the Navy's aviation training program and is presently assigned to DCNO (Air).



Better Pilots ▪ Less Air Sea Rescue

recent war has brought the human tragedy olossal waste of aviation accidents into sharp Aviation accidents bring to light the expected : between a "humane" philosophy and a philos- f war. A bird's-eye view of the war history re- ie initial philosophy of war as demanding mass- ticn of aircraft, of pilots, and of immediate Soon, however, the plethora of human trag- nodified this initial philosophy by placing ap- ite emphasis upon the merciful operations of rescue, survival, and efficient crash-fire units. s ironically the "humane" philosophy sup- the philosophy of war in that the results d, the saving of pilots' lives, more than war- the expense and effort, even as a military ex- :. Thus, once again the initial philosophy of as modified to include aviation safety units l with the specific task of preventing aviation its. Here, too, the practical results in maté- d lives saved more than warranted the time ffort. The preventon of—the protection —and the survival from aviation accidents continues to assume a practical bond of humane and military necessity in times of peace as in war.

The recent war has been so consistently expounded as a war of supply and matériel mass-production that we are not likely to forget the giant strides forward in the tangible engineering aspects. However, the simultaneous progress in the training of thousands and thousands of youths from all walks of life in the technical specialties of war has rarely been emphasized, and will easily be forgotten. If not recorded, this great progress with personnel may be lost sight of. Very fortunately, in aviation such gains fare well in their prospect of being maintained. The wartime mass-production of pilots, for example, has provided the military aeronautical organization with a wealth of information relative to the selection and training of "better" pilots. Furthermore, on the basis of pure economic necessity, the peacetime aeronautical organization demands "better" pilots.

Such an apparently simple term as "better" pilots signifies certain limitations. First, much like professional baseball or football, the "active" participa-

tion in aviation is a job for youth. Secondly, the designated aviators of the present will become the aviation administrators of the near future. Finally, therefore, to provide "better" pilots—that is, pilots who will be most likely to survive all obstacles in aviation throughout their early adult life—we are forced to place major emphasis upon the selection and training of students now entering the training program.

The term better pilots also connotes a group of far reaching implications. In the first place, the better pilot must present sufficient capabilities in coordination and dexterity to master all types of aircraft and all types of maneuvers required of an exacting training syllabus. Since these attributes are modified to a considerable extent by the time-element, it might be assumed that with the increasing landing speeds of future aircraft, the designated pilots of the future will be drawn rather heavily from those presenting a high degree of dexterity. In peacetime aviation training, the psychological and adjustment attributes pertaining to all flights are segregated from the coordination and dexterity maneuvers. In essence all flights become check-flights. Instructors will be urged continually to distinguish between the student's coordination and dexterity, e. g. "ability", to accomplish a specific maneuver, and his associated adjustment, e. g. headwork, attitude, and mental reactions. Rigid enforcement of these standards will provide not only a sound basis upon which to designate pilots, but will provide more accurate validation of selective tests for coordination and dexterity utilized prior to actual flight.

Secondly, irrespective of a student's apparent proficiency of coordination and dexterity, the designated peacetime student will be required to present a high degree of "headwork" throughout all of his training. While the term "headwork" is definitely a loose catch-all, its use has become so firmly entrenched in the jargon of aviation that its use must be accepted. In brief, designated pilots will be drawn from students who have consistently "gotten-the-word"—they know, think, remember, pay attention, plan, and use good judgment. As a unit, these words embody the important aviation term headwork. All too often in the past, air-sea rescue has been called upon to aid the injured resulting from an aviation accident that could have been avoided entirely by good headwork. The problem is not superficial, for the inherent headwork with all that it connotes, plus emotional stability and motivation, predetermine even the student's response to instruction. If the aviation term headwork is analyzed, it will be noted to involve a chain of e attention, concentration, memory, association judgment. First, let us consider attention. (war-time instructors became very adept in the demanding student attention, although even best efforts in some instances failed to bring c students into an efficient and consistent sta "being aware". The failure of some students t attention was logically explained by a below-par tional stability, or low motivation. Howeve: inattentiveness of by far the larger group of the: dents remained a mystery to even the clever anc scientious instructor and he was glad to pass his b on to succeeding instructors. In retrospect, w frank to admit this error as the way of least resis In defense, we might say that we were not sur to find aviation facing the problem of inatte Inattention is a normal human deficiency, perh: emphasized by the multiple, apparently nec attention mechanisms in use by the newspap their headlines, the magazines by their color, t vertisers by their repetition and slogans, the ra its use of strange sounds and gags, and facetious women with their cosmetics and nylons. In avi pilots must pay a high degree of attention altimeter, the airspeed, the fuel supply, other ai the wheels and flaps levers, the operating restr imposed on their aircraft, etc. Anything less, a pilot becomes a candidate for a serious aviatio dent. With *failure to pay attention* so lucr inserted in a majority of our aviation accident r it behooves us to designate pilots presenting a mum of this human deficiency.

When the time element is added to attentio term "concentration" is evolved. In essence centration is the ability of the pilot to bring faculties to bear upon one course of thought or The numerous distractions peculiar to the m ment of an aircraft are not conducive to long p of concentration. The disadvantages of the time interval imposed on the thought pattern aviator cannot be underestimated. Attentio concentration are linked together, and thus al has been stated concerning attention can be a equally well to concentration. In passing, it is sary to note that without a high basic level of tion and concentration in the student, the two members of the headwork chain—memor association—stand little chance for perfection. ory is the power of reproducing what has been l and/or experienced. Association is the menta nection of ideas as established by the process of

These two mental processes are very intimately d, and they form the basis for continued and pro- ive success in aviation. The war has taught us survival in aviation is in direct proportion to the ιding progress of the student. Many students as sult of the unusual environment have started y in their flight training with many correctible :ts of technique, but their progress was consistent their retention superior. It is not the intent of ›resent quest for better pilots to deny this type of :nt a fair "test of flight".

ith the time element added to attention, memory, association, the aviation term "judgment" is ·ed. Judgment is the power of quickly arriving at e decision on the basis of indications and proba- :s. In all aviation emergencies the initial judg- must be final, almost reflex in character, void of :ision or the possibility for subsequent modifica-

Judgment in the air demands little of the pilot's ination. In fact, where imagination enters the re too heavily, the aviator's memory and associa- ıre so inhibited that decisions are colored, ofttimes ; detriment. The failure of the headwork chain ental processes—attention, concentration, mem- association, and judgment, has accounted for a rity of our fatal aviation accidents.

ιe third major demand that will be made of desig- l student pilots is a high and consistent degree of iscipline. In the past, certain types of aviation ents have demonstrated the importance of this ›ute. With *poor air discipline* so frequently in- l in the majority of this group of accident reports, :omes paramount that some attempt be made to nate pilots presenting a minimum of this defi- y. Unfortunately, during the war the term came clude certain examples of poor headwork, the nt's adverse mental attitude, and even flight vio- ıs. There is no doubt that the term air discipline criptive and useful. To stabilize its use therefore, ıctors will restrict it to minor nonobservance of ', the check-off list, ground rules, area rules, course and other aircraft. Major infractions of air ›line which are subject to disciplinary action will cluded under a separate category—Flight Viola-

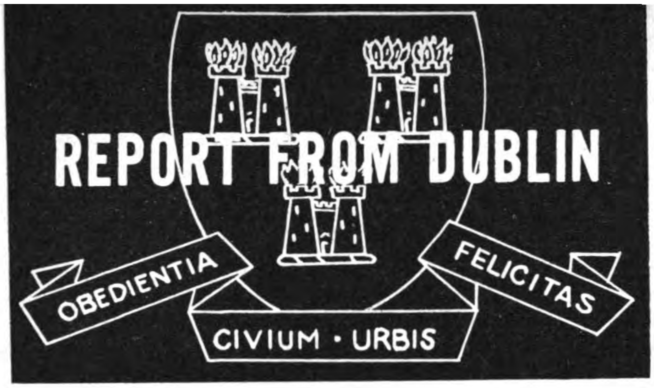
In all cases, the student will be cognizant of the sity for the observance of such rules of safety as ›mpatible with his stage of training. In this light, mphasis is definitely upon discipline, and infrac- will be assumed to present a fair index of the in- ual's inherent non-conformity. In some occupa- non-conformity can be safely overlooked. In :on, conformity is paramount.

The fourth major demand that will be made of the designated student will be a consistently high degree of emotional stability. War experience has repeatedly demonstrated that the emotional tenseness developed under pressure of a check-flight, "checkitis", which is so familiar to all students undergoing training, invalidates the use of the aviation check flight alone as a measure of coordination and dexterity. However, the student's emotional stability is sorely tried in adjusting to even the daily changing environment of aviation. Therefore, the indices of emotional stability so clearly demonstrated in the early phases of a student's daily training become a logical forecast of his adjustment to subsequent training environment, as well as his ability to survive all obstacles in aviation throughout his early adult life. In practice, instructors will continuously observe the student's reactions toward: (*a*) spins and stalls, (*b*) landings, (*c*) emergencies, (*d*) formation flying, (*e*) instrument flying, and (*f*) night flying. They will specifically observe, in each one of these categories, nervousness, tenseness, confusion, air sickness, and lack of confidence, or fear.

The fifth major demand that will be made of the designated student will be a consistently favorable mental attitude. The mental attitude of a student is primarily controlled by his motivation. As a result of causative factors too numerous to mention here, both mental attitude and motivation will reflect the failure of a small group of students to adjust adequately to the rigors of aviation. In practice, instructors will continuously observe and record the student's mental attitude as evidenced by his desire for flying, his apparent indifference or impatience, his aggressive attitude, his cooperativeness, and his precisiveness and exactness. During the war, motivation received an enormous although intangible stimulus from the glory of ribbons, and the mass psychology of war. With both of these factors absent in the peacetime era, it is likely that motivation will not reach the high level of war years. However, it is believed that the more mature and serious youth attracted by the peacetime training program will more than offset these more or less artificial motivation stimulants.

The sixth major demand that will be made of the designated student pilot will be a consistently high level of ground school proficiency. Ground school proficiency is a measure of the student's intellectual adjustment, that is, his desire and ability to learn. Discounting the adjustment factors common to aviation, all that has been said concerning the term headwork and the mental processes concerning response to instruc-

(*Continued on Page 52*)



Following plans formulated at the meeting in Montreal in January, the first regional meeting of PICAO North Atlantic Route Service Conference was held in Dublin, Ireland, March 1946. Delegates attending were from governments interested on the basis of territorial location within which the meeting was held; of actual or prospective operation of airlines within the region; or of contribution of facilities for international air transport within the region.

Governments represented were Canada, Denmark, France, Iceland, Ireland, Netherlands, Norway, Portugal, Spain, United Kingdom, and the United States. Observing states were Australia, China, and Egypt.

At this meeting the SAR committee of PICAO formulated its final report for development of the rescue services of the world into a globe-encompassing network. This report is now before the Council of PICAO for approval and implementation. Those parts of the report printed here were chosen because of their special interest to Bulletin readers.

SECTION I

FROM REPORT OF THE CHAIRMAN, SAR COMMITTEE TO THE GENERAL COMMITTEE

1.

The SAR Committee of the Conference met in Dublin Castle from 5th March, 1946 to 22nd March, 1946, under the chairmanship of Commodore E. M. Webster, representative of the United States of America. The Vice-Chairman of the Committee was Sqd. Ldr. N. V. Lindemere, representative of the United Kingdom. Twenty-six meetings of the Committee were held during the session.

An ad hoc Committee was appointed to consider and draft proposals in respect of Items 1 and 2 and certain aspect of Items 5 and 6 of the Agenda. This Committee met on several occasions under the chairmanship of Sqd. Ldr. N. V. Lindemere (United Kingdom) and draft proposals were considered by the main committee and incorporated in the recommendations.

2.

The following countries and International Oı izations were represented on the Committee:

Chairman: Commodore E. M. Webster—United States

CONFERENCE STATES

Delegates

Mr. A. C. McKim	Canada
Sgd. Ldr. R. J. Lehman	Canada
Lt. Cdr. S. Dalbro	Denmark
Mr. G. E. Teisen	Denmark
Cmdr. L. Bedin	France
Mr. S. Briem	Iceland
Mr. S. H. Gudmundsson	Iceland
Mr. A. Kofoed-Hansen	Iceland
Mr. O. J. Olason	Iceland
Capt. H. Freyne	Ireland
Mr. R. W. O'Sullivan	Ireland
Mr. T. Varekamp	Netherlands
Lt. Cmdr. B. Grinde	Norway
Capt. H. Steen	Norway
Mr. H. Ferredra	Portugal
Comdr. de Sousa Uva	Portugal
Senor U. Kindelan	Spain
Senor C. Pombo	Spain
Senor L. Villalba	Spain
Mr. J. G. Murray	United Ki
Mr. N. V. Lindemere (Vice-Chairman)	United Ki
Mr. H. P. Finch	United Ki
Group Capt. G. M. Bryer	United Ki
Mr. C. North	United Ki
Mr. A. H. Read	United Ki
Mr. P. H. Reinold	United Kir
Mr. A. C. Lorraine	United Kir (BOAC.)
Mr. I. F. B. Walters	United Kir (BOAC.)
Mr. T. L. Boyd	United Stat
Mr. F. O'Beirne	United Stat
Mr. A. E. Harned	United Stat
Mr. R. D. Hoyt	United Stat
Mr. J. L. Kinney	United Stat
Mr. R. H. Kruse	United Stat
Mr. R. F. Nickolson	United Stat
Mr. D. W. Nyrop	United Stat
Mr. A. Osbourne	United Stat
Mr. E. C. Phillips	United Stat
Mr. R. F. Nicholson	United Stat
Mr. D. W. Rentzel	United Stat
Mr. W. B. Scheibel	United Stat
Mr. J. H. Smith (jr.)	United Stat
Mr. E. L. White	United Stat

Observers

Col. W. P. Delamere	Ireland

:RVING STATES

\. R. McComb	Australia
C. F. Wang	China
ndr. H. Akef	Egypt
Lr. I. H. Gazarine	Egypt

ıational Air Transport Association (I. A. T. A.)

ı. S. Stevens

ined Air Traffic Advisory Committee (C. A. T. A. C.) ırope)

Ir. L. L. Johnston.

C. A. O.

ol. N. D. Vaughan
). Lefevre
ıt. L. Livet
/. Davey
Y. Aganier

1. An average of twenty-five persons attended Committee Meetings.

3.

ıe duties of the Secretariat were performed by:

{. C. O'Connor, Department of Industry and Comıce—Ireland.

/. O. Boyle, Department of Industry and Commerce—and.

6.

.e deliberations of the SAR Committee were carɔut bearing in mind the desirability of future coation in the Search and Rescue field between national Maritime, Telecommunication and ion interests.

7.

its deliberations, the Committee was ever mind- the cost of operating special facilities for Search {escue purposes and regard was had to the views : Operating Companies on this aspect. For this ı all facilities were considered from three points w.—

. The ideally desirable range of facilities;

!. The facilities immediately available without cost;

3. The further facilities desirable, the cost question being for consideration by PICAO.

The feeling existed, however, that it was possible hat the maintenance of permanent Search and {escue facilities would be more economical in the ggregate than the operation of improvised and ınco-ordinated search in cases of emergency ʻhere the costs would be extremely high owing ɔ lack of organization.

. *It was considered also that the Committee should state clearly that any recommendation for facilities which would effect less than full Search and Rescue coverage was influenced by consideration of the cost element and that it would be a matter for the PICAO Council to decide as to whether the reduction in cost would justify the reduction in coverage.*

8.

One of the main difficulties affecting the consideration of present and future problems was the fact that previous peacetime operation of Transatlantic civil aviation was not of sufficient volume to bear relation to present and future considerations in the matter of organized Search and Rescue. The greater part of the experience and practice in this field has developed under war conditions, where the main consideration was the preservation of essential personnel and where the question of cost was not prominent. Under peacetime conditions the question of economical operation of air transport must also be considered.

11.

It was agreed by the Committee that Ocean Station Vessels would be of importance to Search and Rescue in the North Atlantic. It was understood that such vessels would also be of importance in the requirements of other Committees and accordingly close liaison was maintained through the Co-Ordinating Committee with the MET., COM, and ATC Committees on this subject.

13.

1., C., (f) *The Committee recommended* that the following be approved and issued as a statement of policy in amplification of the obligations on each Member State:

Efficient, economical and safe aircraft operation is attained through consideration of design, materials, trained personnel, flight procedures, weather information, and navigational aids. While every effort is thus made to provide for the unexpected, nevertheless the fallibility of machines and humans and the inconsistencies of weather make these provisions under present conditions incomplete without a Search and Rescue Organization. Safety, used in its broad sense, is the phase preceding Search and Rescue. A high degree of effectiveness in safety in its specific application will normally reduce the occasions on which Search and Rescue is required. Nevertheless, recognizing a requirement for Search and Rescue, certain facilities must be considered essential. It is noted that many facilities are already provided for other reasons and are available for this purpose. These facilities can be organized and coordinated to effect the results desired in providing assistance. This fact was recognized early in

PICAO Headquarters meetings for Search and Rescue and led to the provisions for establishment of Rescue Coordination Centers. The very word "Coordination" in the title of the Rescue Coordination Centers defines the purpose to be accomplished. Recognizing that there may be cases in which facilities available fall short of acceptable minima, consideration must be given to Search and Rescue provisions necessary to fulfil the obligations of Member States as laid down by PICAO. The solution arrived at must be at the point of acceptable compromise between the existing and the ideal. Additional facilities required represent the difference between those which are currently available and those believed to be the ideal. This difference is invariably one of degree and the determination of the exact degree rests entirely upon the judgment of those responsible for the decisions and not necessarily upon tangible elements.

The responsibility of any regional group dealing with Search and Rescue matters goes beyond the point of benign generalities. The accomplishments of such a group must be such that, when combined with those of other groups working towards similar ends, will result in acceptance by the public that the unavoidable risks of civil aviation are cared for by a necessary and efficient organization.

2., B. *The Committee recommends as follows:*

That the Regional Secretariat for the North Atlantic Route should contain, at least for the first twelve months of its existence, a fully qualified expert on Search and Rescue whose duties will specifically include:

2., B., (a) the coordination of SAR facilities with ATC and COM facilities; and also, *under the supervision of the Regional Secretariat,*

(b) the dissemination to Member States of information and advice regarding SAR, including changes in location and type of facilities,

(c) keeping familiar and exercising liaison, through personal visits, with Search and Rescue Organizations of Member States,

(d) advising on the methods and procedures of organization of Rescue Coordination Centers and other facilities in the manner most suitable to the circumstances.

(e) the collection, coordination and distribution of operating plans of Rescue Coordination Centers within the Region,

(f) fostering the instruction of the civil population of Member States as to the reporting of incidents and as to the necessity for so doing;

(g) preparing and keeping amended a chart or charts of the North Atlantic Region, as required, showing:

1—Rescue Coordination Centers.
2—Long range rescue aircraft bases.
3—Medium range rescue aircraft bases.
4—Rescue Seaplane bases.
5—Short range rescue aircraft bases.
6—Land rescue units.
7—Off-shore rescue boat bases.
8—Helicopter bases.
9—Ocean station vessels.
10—Winter and summer ocean shipp tracks.
11—Other Search and Rescue informati

(h) planning and carrying out Rescue exerci between Rescue Coordination Centers;

(j) consideration and report to PICAO of p sible measures for Coordination with other PIC route service organizations adjacent to the No Atlantic area to ensure maximum uniformity a availability of Search and Rescue services a facilities.

C. *The Committee also resolved as follou* Contemplating that, when the arrangeme necessary for the coordination of facilities volve more than one region, the regions involv by mutual agreement will authorize a designat secretariat from one of their number to act the interests in negotiating with the Memb State, the Committee resolves that the Regior Secretariat be designated the duty outlin above and by direction of the Council, make necessary provision for accomplishment of t terms herein specified.

D. *The Committee further resolved* tl Member States be encouraged to reque through PICAO Headquarters or directly l tween the States involved, the temporary assig ment of specialists from Canada, United Kir dom or United States to aid the requesting St in setting up its Search and Rescue Organizatio

E. *The Committee recommends* that the A Sea Rescue Agency be requested to prepare t or more films for circulation among all Memb States within the North Atlantic Route Servi Organization for the purpose of instructions Search and Rescue Air and Ground Crews wi the expectation of a general improvement Search and Rescue operations throughout t area.

15.

1.—*The Committee recommends* that Contra ing States be encouraged to furnish information to the position, course and speed of major mercha vessels in the North Atlantic area to the appropria authority for the information of air crews.

The following paragraphs are the recommendations the committee members for knitting existing SAR fac ties into an effective coordinated program, and for t

opment of the probable means which it is hoped esult in adequate SAR coverage. Based on a purely ical view, the committee recommends the eight-base outlined below and leaves the question of economics PICAO Council.

SECTION II
APPENDIX B 2.2.2

:AFT FOR ROUTE SERVICE MANUAL

1.

—Search and Rescue: The act of finding and urning to safety the survivors from an emergency ident.

3—Search and Rescue Area: The area in which rch and Rescue incidents become the responsity of a particular Rescue Coordination Center.

3.

—When information is received that the position an aircraft is so questionable as to give rise to ıbt as to its safety.

!—When information is received that an aircraft definitely made a forced landing or is about to so. (This shall be considered to mean a forced ding made in distress.)

—When information is received that personnel 'e abandoned an aircraft during flight.

4.

—The organizations and procedures for operaı within the North Atlantic PICAO Regional ute Service Organization shall be as shown in the CAO Route Service Manual (North Atlantic :a).

6.

—The composition and location of Rescue Coination Centers, the duties and responsibilities of h centers, and their areas of responsibility shall as shown in the PICAO Route Service Manual orth Atlantic Area).

—For the purposes of administrative convence, Search and Rescue Areas may be divided into -Areas. Each Sub-Area may contain appropri- Rescue Coordination Sub-Centers.

7.

1—The composition and location of Rescue Units, the duties and responsibilities of such Units and their areas of operation shall be as shown in the PICAO Route Service Manual (North Atlantic Area).

2—For the purpose of the North Atlantic PICAO Regional Route Service Organization, it is required that rescue aircraft be so located in areas, and be capable of such speed and range, that they will be able to arrive at the scene of distress within the shortest possible time.

9.

1—Aircraft believed in need of Search and Rescue assistance shall be reported to the appropriate authority as shown in the PICAO Route Service Manual (North Atlantic Area).

10.

1—The actions of a Rescue Cordination Center shall be conducted in accordance with the PICAO Route Service Manual (North Atlantic Area).

2—The operating agency of any aircraft reported to be in need of Search and Rescue assistance shall be advised of the situation as soon as practicable by the Rescue Coordination Center, and shall be kept informed of pertinent developments.

13.

1—The Rescue Coordination Center shall have available to it a plot of air and surface craft, and contracting states shall encourage the furnishing of ships' position information to the surface plotting centers.

16.

Information concerning any changes or contemplated changes in the status or location of any facility established primarily for the safety of air transportation or use by the Search and Rescue Service shall be disseminated as widely as possible by the administration concerned by means of a Notice to Airmen message, appropriately classified as to precedence in accordance with the urgency of the effected or contemplated change. The PICAO Regional Secretariat shall also be notified.

17.

As the effectiveness and usefulness of Search and Rescue procedures and techniques is dependent on

the extent to which airmen are familiar with action to be taken at any instant involving a case of emergency, Contracting States should take all steps necessary to insure such familiarity.

SECTION II
APPENDIX B2.2.1
attachment A

1.

The number, type and location of aircraft to be provided for search must be based on the probable time that survivors may continue life. A search would be futile unless the aircraft can reach the location of an incident and provide relief for survivors before life is extinct.

2.

Experience in the North Atlantic, particularly during the past few years, indicates that, even if survivors succeed in launching and occupying a rubber or other life raft, their life expectancy is very short. This time will be influenced by the season; sea conditions, injuries experienced and whether the survivors have been immersed during the incident.

1—Considering the above, in the ideal situation sufficient aircraft, properly based, should be provided so that any part of the seas traversed by aircraft can be reached and an appropriate area searched in not more than 9½ hours.

3.

Having regard to the many variables which a search involves, the Committee established an area, for the purpose of illustration, to be a rectangle 150 miles long (300 m. p. h. ground speed for ½ hour duration) by 40 miles wide (20 miles on each side of the track), equalling 6000 square miles to be searched. Realizing that a 3-aircraft search team is most desirable and can search approximately 1,000 square miles, at maximum range, 15 aircraft would be required for the search area of 6,000 square miles. Since it is obviously, financially impracticable to establish this number of search aircraft at the required bases, the Committee agrees that, from experience available, 3 long range aircraft at each required base wc represent an estimated minimum requirement.

4.

The ideally located bases for these minimum quirements of 3 long range search aircraft ar follows:

750 mile radius before search (Lancaster or equivalent)	1,000 mile radius be search (B17 or equival
Shannon	Iceland
Lisbon	Greenland—BWI
Argentia	Azores
	New York
	Bermuda

1—This choice of base is not obtainable in p tice, and the situation was, therefore, studied wi view to the maximum utilization of existing f ities, both civil and military.

5.

Facilities exist at the moment and are mainly vided by the military organization in the follov bases: Northern Scotland, Southern England, muda, New York, Halifax, Newfoundland.

1—The Committee considers that it can rea ably assume that such facilities will be maintai in the course of the next 18 months. It further lieves that the PICAO Council could readily range with the governments concerned that military organization will agree to maintain at l three long range aircraft in continuous operatic status at each of those latter-mentioned bases.

6.

However, from the route proposals shown on c and DOC. D.68GEN/D.5, it is clear that a very g deal of the North Atlantic air traffic will pass thro or near Iceland. Further, aircraft using the di (Great Circle) route, Gander-Shannon, will be wi 600 miles of Iceland. The northern routes (vici of Iceland) projected for the Atlantic are over a where there are few vessels. The provision of a l in Iceland means a possibility of reducing by half time necessary for reaching the place of incident that area.

7.

Similarly, if we examine the same problem relation to the Azores, we find that, from the long ra search point of view, there are blank spots to northwest and west of the said Islands outside seven hour range of aircraft based elsewhere, altho

r traffic in this area is not so heavy as in the :rn area.

8.

considering this problem, cognizance has been of the density of surface vessels as affecting the ity for search. It is realized that, in those areas many vessels may be expected, search may be ed since aircraft may ditch in the vicinity of a e vessel.

9.

'ing taken into consideration these and other tant factors such as weather and sea conditions ommittee considers the establishment of bases 1 Iceland and the Azores as most desirable, and 1e Iceland base is of relatively more importance. : use of the above two bases, plus the six pre- / named—all parts of the Atlantic can be cov- y three or more aircraft within 7 hours of take d all the other basic requirements of long range 'ater search can be met.

10.

1as been considered by the Committee that ary arrangements could be made with appro- governments to provide aircraft and other such es in Iceland and the Azores, but at some con- ble extra cost to PICAO or the member states. dition, it must be kept in mind that establish- of long range search bases in Iceland and the will be at the cost of establishment and main- :e of two bases which will have only partial for other than search purposes. In this con- 1, the known record of the operating companies espect to safety may indicate that the cost of shment of the bases in Iceland and the Azores ot be justified and that the extra risk outlined 1graphs 12.2.1, 12.2.2, 12.2.3, 12.2.4, and 12.2.A, below should be assumed. It is, however, un- od that proposals are before the MET. Com- to establish Met. flights in Iceland and the . In the event of these proposals being passed t Committee, it is recommended that considera- given to the establishment of long range air- it these bases for the joint purposes of MET. \R.

11.

Committee has considered the necessity of 1ining long range search facilities at the follow- ses:—

1, Iceland; 2, Northern Scotland; 3, Southern England; 4, Azores; 5, Bermuda; 6, New York; 8, Newfoundland.

12.

Because of the cost element, and as a further practical compromise we examine in the following paragraphs the possibility of reducing the number of long range search bases by accepting a principle of the use of alternate aerodromes for refuelling.

1—It may be pointed out that the North Atlantic can be searched by aircraft even though bases are not established in the Azores and Iceland. To carry out this system long range aircraft based in Newfoundland and Southern England, Northern Scotland, Bermuda, New York and Halifax would operate on the principle of leaving the home base, carrying out at least a 2½ hour search and landing at an alternate base for refuelling.

2—This system has the advantage of being possible of establishment without extra cost to PICAO or member states, but at the same time such a search system would have the following disadvantages.

A. As longer distances are in some cases involved the time of arrival at the incident is delayed.

B. Since there is a less number of available search aircraft bases involved, the possibility of search aircraft being "weathered in" at the time of an incident is increased.

C. Increased distance of flight before search increases the importance of possible navigational errors on the part of search aircraft and would thus require the search of a larger area.

D. The longer flight time would in a measure reduce the efficiency of observers at the time search is initiated.

13.

With these considerations in mind, the Committee, from a purely technical point of view recommends the 8 base plan outlined herein and leaves the question of economics to the PICAO Council. Should it be impossible to resolve that question of economics, the Committee submits for secondary consideration the suggestion examined in Paragraph 12 of this Document.

The PICAO SAR Standards (SAR/54/23/11/45) agreed upon at Montreal and published in the February issue of the Air Sea Rescue Bulletin were accepted at the Dublin meeting but amplified for regional use.

SECTION II
APPENDIX B 2.2.1

FROM THE REPORT OF THE SEARCH AND RESCUE COMMITTEE ON FACILITIES FOR SEARCH AND RESCUE WITHIN THE NORTH ATLANTIC REGION

1.

The Committee received from the several states reports of their SAR facilities now existing for their internal requirements. From these the Committee nominated those bases which would best serve the needs of the North Atlantic Route Service. Instead of specifying more ideal but not so readily provided facilities, the Committee believes that PICAO may with more confidence ask the States concerned to provide and maintain the facilities required, as described below. In the event of a State wishing to rearrange its SAR facilities it would naturally be expected that the minimum needs for the North Atlantic Route Service would be specifically included in the rearrangement.

2.

Rescue Coordination Centers.

Contracting State	Location of R. C. C.
A. Canada	Halifax
B. France	Bordeaux
C. Iceland	Reykjavik
D. Ireland	Shannon
E. Netherlands	Amsterdam
F. Norway	Stavanger
G. Portugal	Azores
H. Portugal	Lisbon
I. Spain	Madrid
J. United Kingdom	Argentia
K. United Kingdom	Bermuda
L. United Kingdom	Prestwick
M. United States	New York

N. The Rescue Coordination Centers located at N York, U. S. A. and Prestwick, U. K. have b allotted additional duties as outlined in the Sea and Rescue Operating Procedures.

1. Search and Rescue Bases and Equipment.

A. Attachment A to this document is a tailed report concerning Long-Range Sea Aircraft Bases.

B. Long Range Search Aircraft.

(Lancasters, 750 mile radius of ac equipped with air-borne lifeboat or C–54 craft, with 2,000 mile radius of action or B aircraft, with 1,000 mile radius of act equipped with airborne lifeboat, or equival The foregoing radii of action allow for a m mum search of 2½ hours duration.)

Contracting State	Location of Base	Minim facilit necess
(a) Canada	Dartmouth	3 La cast
(b) Iceland	Reykjavik	3 C–5 3 B-
(c) Portugal	Azores	3 C–5 3 B-
(d) United Kingdom	Argentia (Newfoundland)	3 B–1
(e) United Kingdom	Bermuda	3 B–1
(f) United Kingdom	Southern England	3 L cast
(g) United Kingdom	North-West Scotland	3 La cast
(h) United Kingdom	New York	3 B–1 3 C-

C. *Medium Range Search Aircraft.*

(500 miles radius of search cover.)

Contracting State	Location of Base	Minim facilit necess
(a) United Kingdom	Bermuda	1 seap
(b) United States	Elizabeth City	2 land- plan
(c) United States	Salem	2 land- plan

D. *Short Range Aircraft.*

(150 miles radius of search cover. Norsemen with skis, pontoons, wheels; Grumman or equivalent.)

Contracting State	Location of base	Minimum facilities necessary
(a) Canada	Dartmouth	1 Norseman
(b) Canada	Seven Islands	1 Norseman
(c) France	Brest	1 aircraft
(d) France	Hourtin (Gironde)	1 aircraft
(e) Ireland	Shannon	1 aircraft
(f) Netherlands	Amsterdam	1 aircraft
(g) Norway	Bergen	1 aircraft
(h) Norway	Stavanger	1 aircraft
(i) Portugal	Lisbon	
(j) United Kingdom	Argentia (Newfoundland)	1 aircraft

Specially Equipped Rescue Boats.

(High speed launches, suggested type 85-foot rescue boat, 25 knots, 100-mile range or equivalent.)

Contracting State	Location of Base	Minimum facilities necessary
(a) Canada	Dartmouth	1 boat
(b) France	Brest	1 boat
(c) France	La Pallice	1 boat
(d) France	St. Jean de Luz	1 boat
(e) Iceland	Reykjavik	1 boat
(f) Netherlands	Netherlands Coast	1 boat
(g) Norway	Bergen	1 boat
(h) Norway	Stavanger	1 boat
(i) Portugal	Ponta del Gada, Azores	1 boat
(j) Portugal	Lisbon	1 boat
(k) Spain	Ferrol	1 boat
(l) United Kingdom	Bermuda	1 boat
(m) United Kingdom	Stephensville, Newfoundland	1 boat
(n) United States	New York	1 boat
(o) United States	Salem	1 boat

F. *Land Rescue Units.*

(To be organized and capable of performing rescues in any season, on mountains, through forests, in snow covered areas with special rescue equipment, such as dog teams, over-snow vehicles, etc., and capable of transportation by air.)

Contracting State	Location of Base	Minimum facilities necessary
(a) Canada	Dartmouth	1 unit
(b) United Kingdom	Stephensville, Newfoundland	1 unit

G. *Ocean Station Vessels*

(a) It is understood that certain Ocean Station Vessels are being recommended for the provision of several coordinated services relating to the safety of air transportation in the North Atlantic Region. The use of Ocean Station Vessels for Search and Rescue purposes and a recommended order of priority from the Search and Rescue point of view are outlined in Appendix D 2.4.6.

H. *Helicopters*

The Committee considers that helicopters, when sufficiently developed, will provide a most important search and rescue facility. If and when performance, production and maintenance problems have been sufficiently improved, arrangements should be made for their location as follows:—

Contracting State	Location of Base	Minimum facilities necessary
(a) Canada	Dartmouth	2 helicopters.
(b) Canada	Seven Isles	1 helicopter.
(c) United Kingdom.	Argentia, Newfoundland.	3 helicopters.
(d) United Kingdom.	Labrador	1 helicopter.
(e) United States	Brunswick, Maine	2 helicopters.
(f) United States	Elizabeth City, N. C.	2 helicopters.
(g) United States	New York	3 helicopters.

3.

In determining the location and number of Rescue Coordination Centres and minimum facilities, only those were considered essential which would, in the

event of their removal or non-existence, jeopardize the adequacy of Search and Rescue, in conformity with the international recommended practices as approved by PICAO. In deciding upon the location of short range facilities the North Atlantic Region was studied with particular reference to points of route entry and exit from land.

4.

The location of the centers and facilities as listed above is believed to be most desirable at the present time. That is not to say, however, that these arrangements could not be improved upon or might not need to be changed at some future date as the result of operating experience.

5.

Numbers of air or marine craft represent those which should be operationally available at any one time. This means that in some cases additional equipment will have to be maintained for rotation, maintenance, and repair.

6.

Facilities

1.—*Canada* now has the Search and Rescue facilities listed above with the exception of long range Search aircraft to be located at Dartmouth to replace the medium range aircraft now located there and the short range aircraft to be located at Dartmouth and the Seven Islands. It is believed that these facilities would be provided upon requ by the Government concerned. In addition Ca ada has a well organized Search and Rescue pı gramme coordinated with that of the U. S. A. a has many additional facilities not listed which c be used for Search and Rescue purposes.

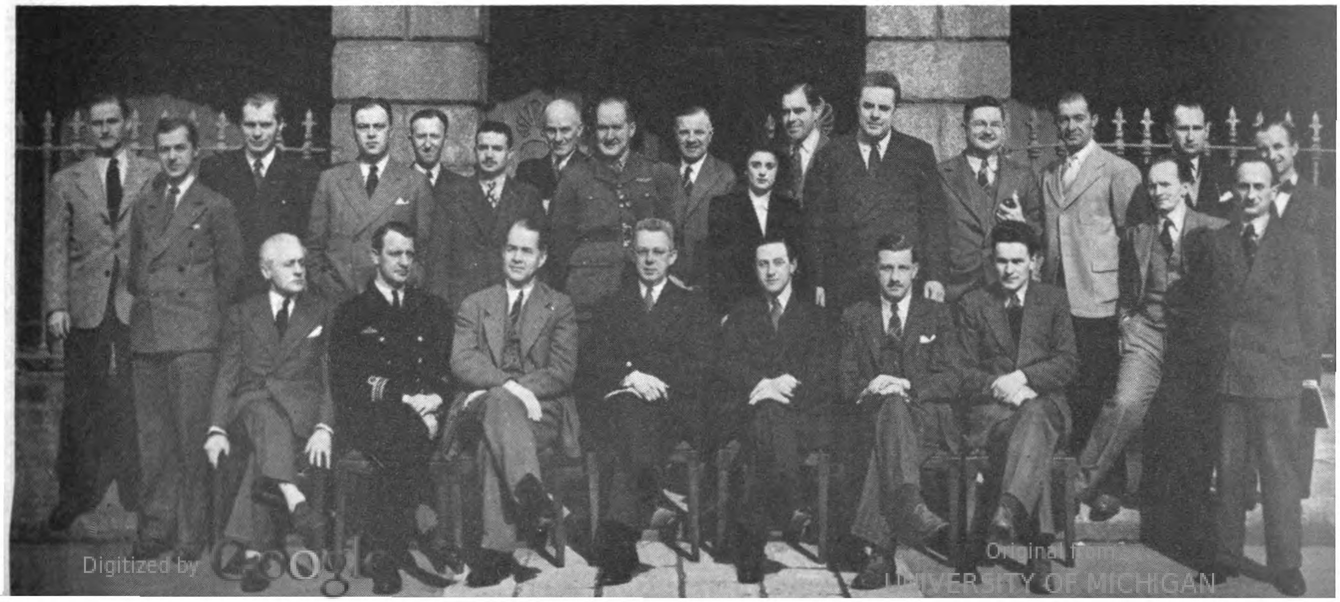
2—*France.* The required facilities exist or c be provided by the State. It is understood tl France has one group of Halifax aircraft located Merignac (Bordeaux) from which a permane small unit is equipped and trained for Long Ran Search purposes. Moreover, the rehabilitation Brest is in progress and even now facilities suital to Search and Rescue operations are available short notice from the French Navy.

3—*Iceland.* It is understood that there are n three privately owned PBY's at Reykjavik. A rangements might be made with the Icelandic Go ernment for the use of these aircraft during t interim period until the provision of the speci long range Search aircraft could be arranged. T provision of these long range aircraft will neces tate outside assistance. Besides these, Iceland h additional facilities, not listed, which can be us for Search and Rescue purposes, on request to t Government.

4—*Ireland.* No aircraft are available at prese The provision of aircraft will require negotiati with the Government. For coastal use, 17 lifeboa

PICAO SAR COMMITTEE

L. to R. (Seated): Comdr. Bedin, France; Lt. Comdr. Dalbro, Denmark; Dr. Warner, President, PICAO; Commo. Webster, U. S., Chairman; W/C Lindemere, U. K., Vice Chairman; Mr. O'Connor, Eire, Secretary; Mr. O'Boyle, Eire, Asst. Secy. L. to R. (Standing): Comdr. Scheibel, U. S.; Mr. Stevens, IATA, Canada; Mr. Kofoed-Hansen, Iceland; S/L Lehman, Canada; Mr. Walters, U. K.; Lt. Comdr. Phillips, U. S.; Mr. Reed, U. K.; Col. Delemere, Eire; G/Capt. Breyer, U. K.; Miss Cabrara, Spain, Interpreter; Col. Vaughan, PICAO, SAR; Mr. Osborne, U. S.; Mr. White, U. S.; Comdr. Harned, U. S.; Mr. Livet, Interpreter PICAO; Mr. Sousa Uva, Portugal; Mr. Haguenav, France; Mr. Pombo, Spain.



)0 mile range, 8 knots, are disposed around the ast.

5—*Netherlands.* It is thought that the off-shore scue boat believed desirable for the coastal area is)t located there at present but that it could be ovided by the State concerned. This requires nfirmation.

6—*Portugal.* In so far as the country of Portugal elf is concerned facilities are in existence with the ception of the Rescue boat at Lisbon. It is be-ved that this boat can be provided by the Govern-ent concerned. In connection with the Azores e provision of the long range aircraft would neces-ate outside facilities for the provision of equip-ent and training of personnel. One appropriate scue craft will be provided by the Government.

7—*Spain.* Required facilities exist or can be pro-ded by the Government concerned. In the case of search which would require the concentration of ore than the minimum agreed facilities and if fficient time were available, Spain would be will-g to transfer, for the occasion, to its North Western gion, the ten search sea-planes at present stationed the Mediterranean.

8—*Scandinavian Area.* The required facilities ist or can be provided by the Governments con-rned.

9—*United Kingdom.* The required facilities are ready in existence. It is anticipated that all arch facilities will be operated by the military thorities. No special vessels were listed as es-ntial for this region as:—

(*a*) The density of merchant shipping below the air approaches to the United Kingdom and

(*b*) The existence of the Royal National Life-boat Institution which operates 137 lifeboat units to render assistance to a depth of 60 miles from the coast and

(*c*) The cooperation of the Admiralty in spe-cial cases were considered sufficient.

A. *Bermuda.* The simplest and most econom-ical way to maintain the SAR unit at Bermuda appears to the Committee to be by a detachment, regularly changed, from similar units based on the Eastern Seaboard of the United States. This would have the additional advantage of familiar-izing all personnel with the local conditions in which they would operate in the event of an incident requiring them to reinforce the unit at Bermuda.

B. *Newfoundland and Labrador.* At present there are two seaplanes and three rescue boats stationed at Argentia for Search and Rescue pur-poses. The period of retention of these forces is uncertain and it is believed that upon request by PICAO the Governments concerned would be willing to retain one rescue vessel and replace the seaplanes by long range aircraft and establish one helicopter at Goose Bay, when practicable.

10—U. S. A.—Facilities as listed above are now in existence with the exception of the medium range rescue aircraft located at Elizabeth City, and Salem, U. S. A. There are now seaplanes at these bases and it is believed that the U. S. would be willing to replace them by land planes in order to comply with this proposed plan. In addition to the minimum facilities outlined herein the U. S. has a rather extensive Search and Rescue Organiza-tion operated by the various military forces. When required, long range rescue facilities from other localities would no doubt be introduced into the designated approach areas to provide rotation of equipment and crews.

7.

Recommendations

1—It is recommended that the Rescue Coordina-tion Centers and the Search and Rescue Facilities outlined in paragraph 2 be accepted as the Search and Rescue programme for the North Atlantic Region.

2—It is also recommended that PICAO should communicate to the Governments concerned that these are the minimum of Search and Rescue re-quirements upon which depends the protection of international civil aviation within the region.

3—It is further recommended that with this pro-gramme in mind PICAO ask the Governments concerned:

A. to continue such of those facilities listed as may now be in existence; the Committee con-siders that this recommendation is a matter of some urgency since some of these facilities may be due to be withdrawn at an early date.

B. to provide those facilities, which may not be in existence at the present time, at the loca-tions specified;

C. to arrange for the provision of long range search aircraft in Iceland and the Azores.

Special Joint Report No. 1 (Ocean Station Vessels) submitted by the Communications and Facilities Committees of the ASR Agency was published in the January issue of the Bulletin. This subject was considered important not only to SAR but also to other technical committees of the North Atlantic Route Service Conference. Excerpts from these documents on the subject of ocean station vessels are as follows:

SECTION II
APPENDIX D 2.4.6

OCEAN STATION VESSELS

1.

The SAR committee has been considering the subject of Ocean Station Vessels, particularly with respect to their use in connection with the general subject of Search and Rescue of distressed persons in the North Atlantic. It has come to the conclusion that such Vessels would serve a most useful purpose to our problem. It is believed that the conclusions of your Committee may be that such Vessels would also be of benefit to the activities in which you are interested. It is therefore our desire to bring certain phases of this subject to your attention.

2.

Station Vessels when established would be used for the benefit of Search and Rescue particularly in the following:

(*a*) By their use as an additional navigational aid, they can improve the quality of air navigation and thus reduce the area required to be searched in case of distress.

(*b*) Further, such Vessels would provide an established fix from which Search aircraft, arriving from divergent points could commence area coverage and would also assist in coordinating the efforts of such aircraft.

(*c*) By reducing the range required of communications, they reduce probably all missing position reports, thus reducing the number of alerts caused by unreported aircraft. The area required to be searched in case of distress would also be reduced.

(*d*) Through use of shipboard D/F and Radar they could improve the accuracy of a fix in the case of distressed aircraft.

(*e*) They would serve as a place near which aircraft could ditch in an ocean area, particularly in those areas through which few surface vessels are routed

(*f*) Through ability to initiate direct and relia communication with surface shipping and due to tl position they can best coordinate cooperation tween aircraft and ships in case of distress.

(*g*) In view of their presence in an otherwise pr tically untraversed ocean area, they would be of treme value in making rescue of distressed pers located by search aircraft.

(*h*) They would serve as an advanced base personnel skilled in the recovery and treatment persons subjected to the hazards of existence in open sea.

(*i*) The knowledge that a Station Vessel is in vicinity and that it is available for rescue would h a valuable psychological effect on all concerned.

3.

It is this Committee's opinion that the views of SAR, MET, COM, and ATC Committees should coordinated in arriving at the decision made w respect to the number of locations and procedures the Ocean Station Vessels.

The question of stationary ships in the Atlantic l been considered by a working party of the M Committee and the following recommendations ma

1—In addition to the normal expectancy of weat reports from merchant ships, at least thirteen oc weather stations are required in order to provide m mum meteorological service to support civil aviat requirements in the North Atlantic.

2—The locations of the above vessels should approximately as follows:

62–00 N,	33–00 W	46–00 N,	29–00
56–30 N,	51–00 W	60–00 N,	20–00
51–45 N,	35–30 W	53–50 N,	18–40
45–00 N,	45–00 W	47–00 N,	18–00
35–30 N,	40–00 W	39–00 N,	17–00
34–00 N,	52–00 W	67–00 N,	00–00
36–00 N,	70–00 W		

The continuance of the two first-named ships regarded as a matter of the utmost importance to sure the safety of North Atlantic air operations.

3—Stationary weather reporting vessels should equipped to provide the following surface and up air observations:

(*a*) Complete and regular surface synoptic obser tions not less than eight times daily.

(*b*) Complete radiosonde observations, not less tl two times daily.

(*c*) Upper wind data (pibal or rawin) not less tl four times daily.

) Special observations of meteorological phe-
·na taken whenever a marked change occurs in her conditions.

-The organization of an ocean weather reporting ·amme should be on a permanent international that would provide for maintenance of stations by ata contributions by member nations.

-The distribution of ships which depends upon otal number of stations, should be determined y by meteorological representatives of the mem- countries after the total number of stations is mined.

The Chairman of the SAR Committee has ad- that his Committee has concluded that Ocean on Vessels would serve a most useful purpose in ection with search and rescue of distressed persons ie North Atlantic (reference DOC. D. 214, .D/27, 14/3/46).

4.

hile the COM COMMITTEE does not desire to the impression that Ocean Station Vessels are utely necessary as radio aids to en route naviga- and operational communication in the North At- :, it is submitted that these vessels, if equipped suitable radio apparatus and if staffed with quali- adio operating and maintenance personnel, would to provide valuable supplemental facilities in espect over the North Atlantic civil air routes.

5.

this end, it is recommended that, if Ocean Station :ls are provided and maintained primarily for reasons, each such vessel be equipped with the apparatus set forth below and be staffed with ecessary radio personnel; in so far as this may be icable:

(*a*) a non-directional MF radio beacon having antenna power preferably of at least 1000 watts. iis beacon should be available for operation at all ies but would be energized only when specific re- est is made and then only for the period of time juired to serve the immediate objective.

(*b*) an aeronautical station of medium power capable of transmitting on the regular airground frequency or frequencies in use at any time, by means of the type of emission normally employed on the route, and capable of continuously guarding the regular airground frequency or frequencies in use.

(*c*) manual point-to-point radiotelegraph facilities capable of affecting reliable operational communication, including continuous guard, with the regularly designated flight control stations of the North Atlantic Route Region and with other Ocean Station Vessels within this region. There appear to be no objections to the use of any MET communication facilities which may be provided for this purpose since the volume of point-to-point operational message traffic is likely to be quite low.

(*d*) apparatus capable of continuous reception and occasional transmission as required for operation on the universal VHF guard frequency which is to be recommended and designated by the COM COMMITTEE at an early date.

At this time the COM COMMITTEE is not endeavouring to specify the type of radio communication and navigation aids deemed necessary to provide the facilities listed by the SAR COMMITTEE, nor those to be listed by the MET COMMITTEE and possibly by the ATC COMMITTEE. Upon receipt of information as to the requirements, the COM COMMITTEE then will prepare an appropriate final report on the subject.

If ocean station vessels are to be provided for such purposes as Meteorology, Search and Rescue, and Communications, these vessels, if properly equipped and suitably located, would provide very valuable services for ATC, such as more accurate Meteorological Reports (Spot-weather) improved communication and navigational aids, and check points for more accurate position reporting and flight planning.

(*Pyrotechnics for ASR—Continued from page 22*)

appeared that an impasse had been reached. There were three reasons for this:

First, the signal would have to be of greater length because of the length of the M–75.

Second, the heavy steel barrel, necessary to direct the stars aloft at the proper angle, would make this combined signal one which would detract from the usefulness of the day signal.

Third, the frequent criticism by air sea rescue teams that it was easier to get a position fix on a stationary flare than on a moving star.

A night flare was finally designed which was built along much the same principles as the day smoke signal, which could be attached bottom to bottom to the day signal without interfering with the use of the day signal. In other words, the new signal was designed so the user could discharge either signal, return the case to the holster in the life jacket, and still have the opposite signal for instant use, regardless of the length of time submerged or the time elapsing from the hour or day when the first signal was used. The new signal was designated Signal (Distress Day and Night) Mark 13 Mod. 0, and in August 1945 the "go ahead" was given to produce a million and a half units for BuAer. The advantages of the new signal were described as follows:

"This signal is 5 x 1⅝ inches in diameter, weighs approximately 7 ounces, and has a volume of 10.3 cubic inches. Of the pyrotechnic items now in use, signals of this type are particularly useful in that they can be carried on the person, or stowed in the folds of the life vest.

"The signals are located at opposite ends of the single container. The night signal can be readily identified in the dark by a series of small humps located around the can. Each signal is operated by a pull ring, and instructions for its use are printed on a label on the container. The advantages of the new signal over other types are:

"(1) Its 10-cubic inch displacement as compared to 13 cubic inches for the existing orange smoke and 2-star red signals.

"(2) The convenience of a combination day and night signal in one unit.

"(3) The simplicity of its ignition, particularly when compared to the 2-star M–75 signal.

"(4) Its greater duration and range of visibility over that of the 2-star M–75 signal.

"(5) It is a waterproofed flare type signal pa ularly suitable for life raft stowage.

"(6) It is readily adaptable for life vest inst tion."

The Navy had set up extremely rigid testing cedure for the initial 600,000 signals. From a lo 200 signals, for instance, 12 were selected at ran for test. The failure of one of these 12 could c the entire lot to be rejected. In subsequent lots, s lar conditions were applied to one failure in 40 sig selected at random from lots of 10,000.

In these tests, the signals were subjected to very temperatures, storage in vacuum, and heat tests lowed by a 24-hour submersion test.

The advent of VJ-day caused the Navy to a the Day and Night Distress Signal for the use of ot of its service branches,

—A replacement for Signal (Distress, Sm Hand) AN–Mark 1 Mod. 1 and Mod. 0, i kits under the cognizance of the aeronau organization. This includes aircraft, life r droppable life rafts, signal kits, shipwreck etc., and in personal equipment kits issued t flight crews.

—A replacement for Very Night Signa Equipment now issued to surface vessel boats—an allowance of twenty-four per life being desired.

—A replacement for Hand Projector Ma and Very Signal Cartridges now include abandon-ship outfits issued to surface vessel rafts and floater nets,—an allowance of tw per life raft and floater net being desired.

A commercial connation of the signal has l established—known and trade-marked as the Day Nite Distress Signal. It is intended to su the great demand from foreign governments, tr oceanic airlines, sportsmen pilots, yachtsmen— an expected use on merchant vessels. However, tary requirements and the shortage of raw mate are likely to retard their manufacture for comme use.

Yet, in spite of man-made safety measures— chanical failure, floods and storms will continue t hazards to the traveller on land, in the air, or on sea. But out of the search and rescue "know h acquired from the wartime experience, we may ex added safety and a higher degree of confidence. may also be assured that the science of pyrotech will keep pace with refinements in the methods techniques of search and rescue, through continue search and development.

(*Better Pilots—Continued from Page 38*)

ıre as true for ground instruction as aviation, e. The war has taught us that without an ıate intellectual adjustment, little can be ex- ɟ of the student's eventual progress and efficiency aviator.

e seventh and final demand that will be made the student prior to designation will be a high e of favorable officer-like qualities. In times of the duties of an aviator are enlarged to such tent by extra-curricular duties as an officer that emphasis must be placed on the designation ıdents presenting not only pilot attributes of a degree, but also the ability to present attributes officer, such as: (*a*) military courtesy, (*b*) uality, (*c*) composure, (*d*) cooperativeness, (*e*) ıent, and (*f*) leadership. With the student of today becoming the aviation administrators future, it is logical to designate only those of ior potentiality.

e seven major categories we have just consid- will be graded on a comparative basis and cu- ed by stages for all students from similar selec- lasses. Aptitude ratings will be drawn prior to ıation or, when indicated, at any other phase ining. The ratings will be drawn individually ll seven categories so that each may be con- d with the collateral aviation data such as: lelinquency reports, (*b*) flight violations, (*c*) actions, (*d*) all aviation accidents, (*e*) medical dings and hospitalization, and (*f*) time in the It is confidently expected that the adequate tion, recording, and utilization of student avia- raining data will lead to the scientific designa- of student pilots who will be most likely to sur- ıll obstacles in aviation throughout their early life.

Our proofreader is in the doghouse! In the Radar story in the April Bulletin—page 9 under the paragraph heading "Indicator Displays"—the range of the optical horizon should be 6 to 10 miles, instead of 60 to 10 miles. However, we've promised our proofreader a fair trial before hanging!

(*Aerologation—Continued from Page 17*)

from southeast, 40–50 knots, to northeast, 50–60 knots. Instead of returning to the desired course, the next fix showed the aircraft to be nearly 100 miles south of course. A computed drift correction, from radio and pressure altimeter readings, showed about 25 degrees correction were required to maintain track, but since the radio altimeter was a relatively new instrument at the time, the navigator compromised and applied a correction of 15 degrees. The next fix showed the flight to be even further south, and a double drift wind measurement proved the wind to be *northeast, 85 knots*. After obtaining this information, the navigator applied sufficient correction to keep from being drifted farther south. When just southwest of the lower tip of Ireland, it was necessary to turn north-northeastward, into the wind, in order to make the desired destination. The wind at this time had decreased to about 45 knots, but still represented a strong head wind on this portion of the flight.

Figure 12 shows the precomputed, constant heading track as determined later from the same forecast map. The constant drift correction needed for this flight would be a -1.5 degrees.

The pressure field shown in figure 12 is the adjusted pressure field from the forecast map, observations made during and after flight. From this chart it is possible to adjust the winds actually encountered on track C, to the precomputed constant heading track B and determine the actual path and flight time of the aircraft had it used this aerologation route. The actual path, in this case, would have been track A. The precomputed drift correction would have been slightly in error, since the forecast pressure for destination was not accurate; however, even if this constant heading had been used, the aircraft would have arrived within forty miles of destination. The navigator could have corrected this heading during the flight, and the aircraft would have arrived very close to destination. It should be noted, from the legend, that the aerologation route was shorter than the great circle route by several hours, and three hours shorter than the actual track made good.

U. S. GOVERNMENT PRINTING OFFICE: 1946

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AIR SEA RESCUE LIAISON OFFICERS

Eastern Sea Frontier

R. L. Burke, *Captain*, USCG
c/o Commander, Eastern Sea Frontier
90 Church St., New York 7, N. Y.

Western Sea Frontier

T. J. Harris, Commander, USCG
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Federal Bldg., San Francisco, Calif.

Philippine Sea Frontier

W. E. Sinton, *Commander*, USCG
Box 3, Philippine Sea Frontier
F. P. O., San Francisco, Calif.

ComAirPac

D. O. Reed, *Commander*, USCG
Coast Guard Box #1
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O. D. Weed, *Commander*, USCG
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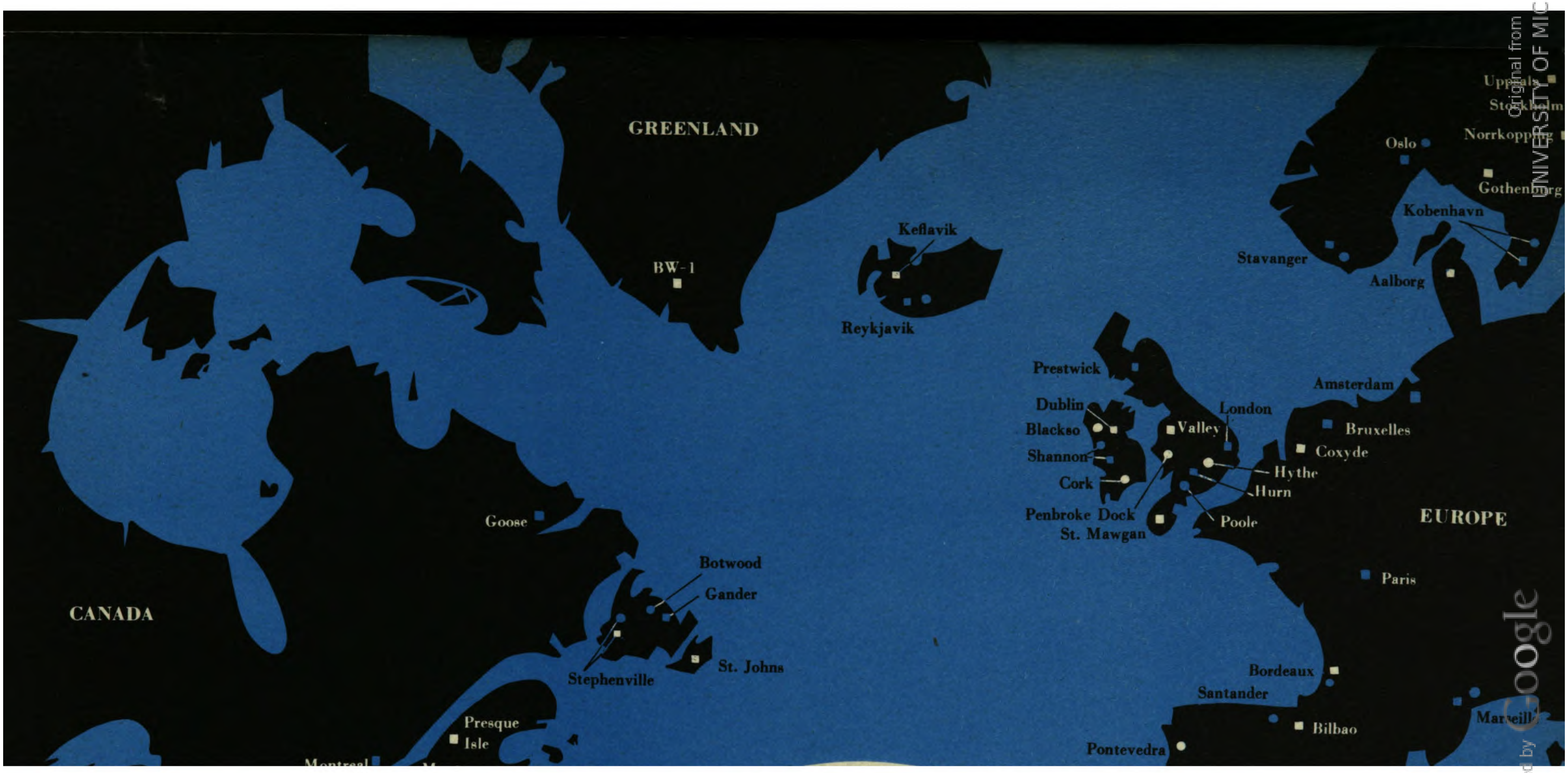
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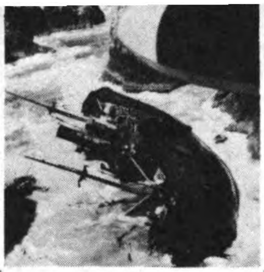

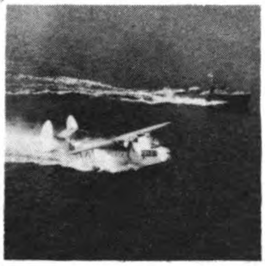

air sea rescue bulletin

rmation contained herein is assembled from various United States foreign sources; it is disseminated in this BULLETIN for information to a limited list of addressees with interest in the field of air-sea ıe and is not for sale. It will be apparent that the BULLETIN may ain information which does not represent the policy of the Air Sea :ue Agency or the Services represented on the Board for Air Sea :ue.

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THIS MONTH'S COVER. Viewed in retrospect, this offi-
cial U. S. Navy photograph would delight the eye of many
to the
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the philosophy of search and rescue

WHEN we look at a map of present and proposed world airways, we are impressed with the preponderance of mileage over water, and over sparsely populated land areas along these routes. Granted that a world war was responsible for making these long-range flights a practical reality, we can be assured that aviation will never again be held within the limits of any one continent, or to relatively short stretches over water.

How much flying over these vast reaches of land and water we may expect in the future will largely depend on the manner and degree of the public's acceptance. There are many reasons why it should be high. Time and money may be saved, comfort enjoyed. What then, could be expected to interfere with complete acceptance? The answer is likely to be . . . lack of confidence based upon the hazards involved.

It is not enough to point out to the potential air traveler that the proportion of aircraft disasters to miles flown is amazingly low; that ships at sea also founder, that trains are sometimes wrecked. Aircraft disasters are still "front page" . . . and a factor which has impressed this traveler unfavorably, has been the small number of survivors in these accidents.

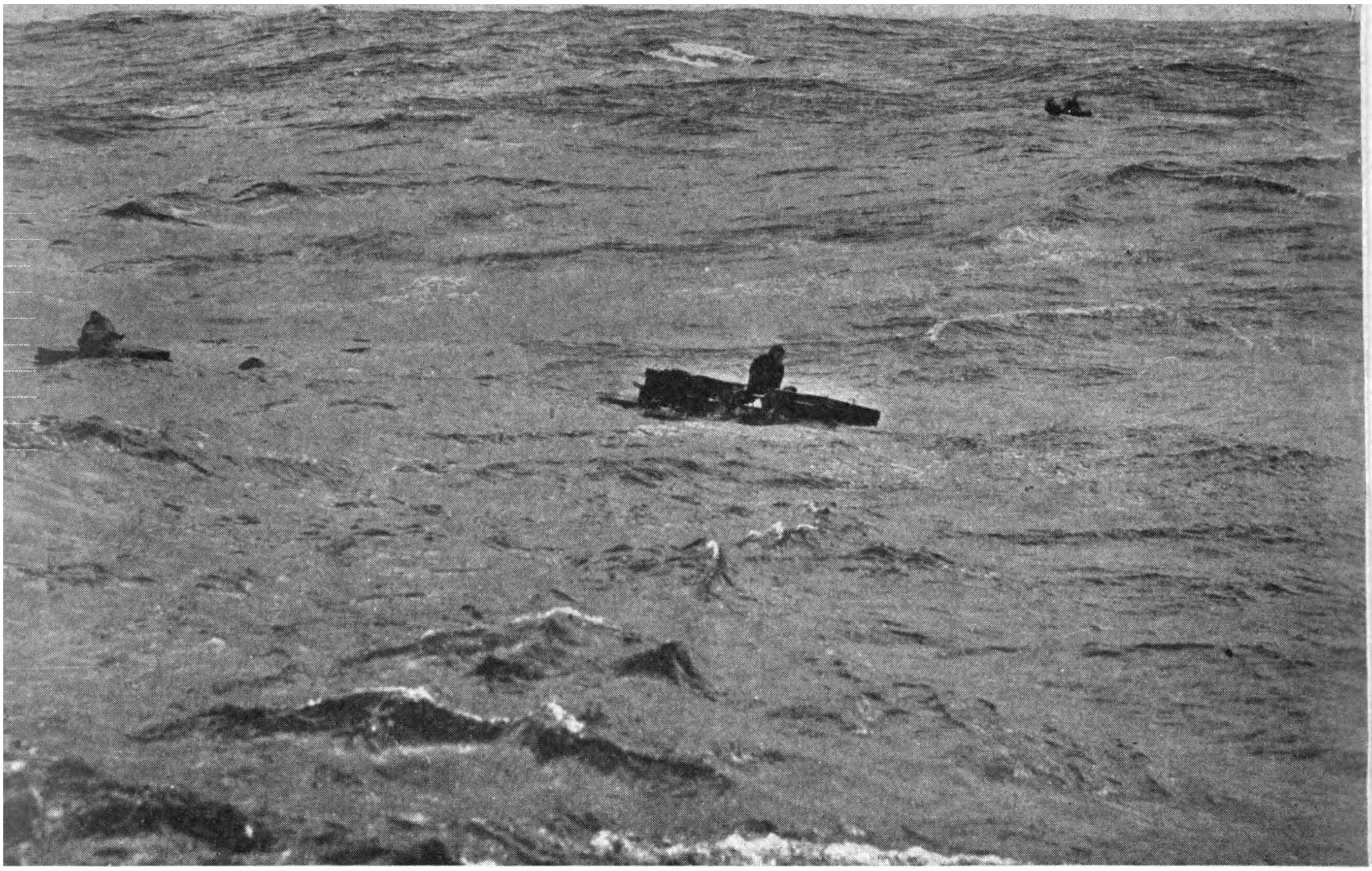
On the other hand, when we examine the wartime statistics of flyers downed in combat, we find that a relatively high percentage of them were rescued, and under conditions which were generally unfavorable.

The reason why so many of these men were saved is because an organized, competent search and rescue service supported combat operations in all theaters of the war. Organization and equipment varied considerably, but basic principles were the same and rescue teams were constantly alert to their responsibilities. Because these combat airmen were aware that an efficient search and rescue service was there to help them, their morale was stepped up, they fought more aggressively. They were willing to fly farther from the security of their bases, confident their chanc rescue and survival were good.

The way to inspire public confidence in avia to persuade the potential air traveler that he i pletely safe in the air, that he may relax, ce worries, that there are no risks off the ground are not encounterable in life's well-known unc ties on the ground. The idea should be presen him that search and rescue was solidly there he came. Further, we must prove to hin the percentage of survivors in aircraft accid higher because of search and rescue . . . anc while it cannot guarantee his safety, it does p him with the maximum of protection.

It is assumed that transoceanic carriers will selves supplement the search and rescue organi by carrying equipment which will make effecti operation possible. Thus they will assist in att the desired international standards of safety. tainly it is more desirable for the carriers to this responsibility in their own right, than to r possibility of Government-imposed regulation conceivably, might contain undesirable eleme rigidity or inflexibility.

It may well be that long periods of time will when search and rescue will not be called up service. So much the better. In fact, it is hoped that international air transport may so achieve standards of safe operation which may eliminate its need. Until that time, howeve a necessary adjunct to our daily lives. It wi tribute invaluably toward the attainment o standards of safety. It will stimulate confide aviation . . . and because friendliness betwe tions, based upon humanitarianism and good a guiding principle for world peace, a worl search and rescue organization will materiall in adding the breath of life to those principl



ɣolution of SAR . . . *an editorial*

Much has been written concerning the history and development of air sea rescue and its peace-time connotation—search and rescue. Yet, because of its sudden emergence from behind a screen of wartime secrecy, and its swift transition from a wartime life-saving function to that of an organized pattern to provide the highest standards of safety to a world-wide airways system—civil and military—it is believed that a reiteration of the story of its evolution and development will serve two useful purposes: (1) It will provide a fund of information upon which we may better evaluate its progress; (2) it will make possible a better understanding of its potentials for service to international aviation. While it may appear to be an old story to those of us who have been intimately associated with the development of air sea rescue, it is nevertheless true that the foundation upon which its future progress will depend will be that which is built upon a complete public understanding of its value.

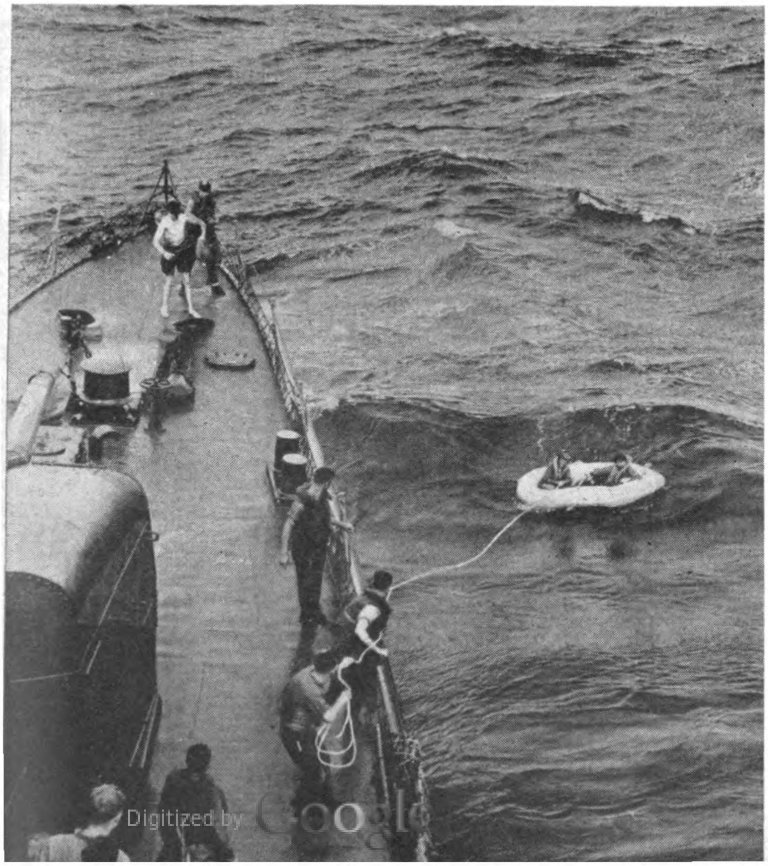
TO MEN who fly and sail over thousands of miles of water each day—the term 'Air Sea e' spells magic—magic in the sense that powerful which frequently combine to destroy have been ıd largely conquered by another powerful force hampions survival." These words of Rear Ad- J. W. Reeves, Jr., Commander of the Naval Air port Service sum up what airmen and mariners raverse long stretches of open water think of rescue.

ordinary individual has only a vague conception of air sea rescue and is likely to tell you that distance no longer means anything. He is thinking of a multi-motored plane with plenty of fuel; he is not visualizing the 68,634,000 square miles of the Pacific as seen from a 7-foot emergency life raft. This same uninitiate is unable to grasp the empty loneliness of the ocean into which a plane or vessel can disappear. He understands only dimly the problems of distance, climate, weather and currents which face the rescue parties who search for the crew of that plane or ship with aircraft and surface vessels. His knowledge of air sea

rescue is comprised of a few well-publicized accounts of dramatic rescues; he knows and understands little or nothing of the extent of the organization that, operating back stage, made these rescues possible. He knows nothing of its exhaustive tests to find the best type of boats for rescue work—the long hours of patient research and development in the field of rescue and survival equipment.

Before World War II there was little need for an extensive air sea rescue organization. Few planes attempted the long overwater flight across the Pacific, and flying under adverse weather conditions was negligible. Most forced landings of aircraft were probably due to mechanical failure, and international merchant shipping services were considered sufficient to care for them, and for the comparatively few cases of marine disaster.

With the advent of war this picture changed rapidly. All types of aircraft were required to fly over water in all kinds of weather. Due to the necessity of speeded-up training, inexperience, according to peacetime standards, was the rule rather than the exception among pilots and crew. Added to these were the normal hazards of war. As a result, forced landings and ditchings increased rapidly, increasing numbers of vessels were sunk or disabled, and with this situation came the need for an increasing rescue coordination.



Official recognition came in May 1940, w original British Air Sea Resue Unit was foı the critical Dover area. The outstanding su this small unit, not only in saving lives but in ing the morale of airmen, gave impetus to the By September 1941, a deputy directorate of rescue was established as a branch of the offic British Directorate General of Aircraft Saf under this unified command responsibility wa: jointly upon fighter, coastal, and naval comm

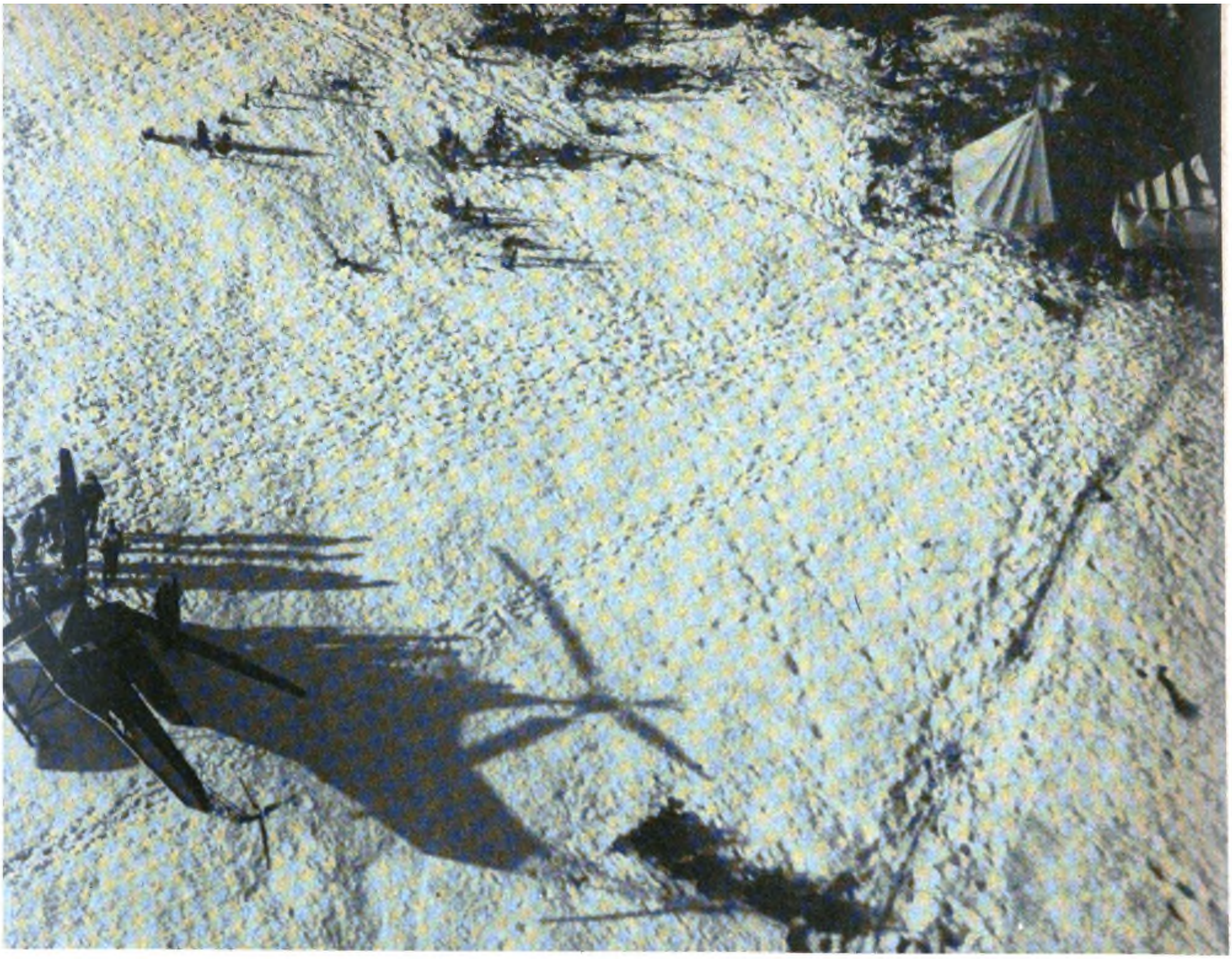
Under this plan air sea rescue made rapid Numerous aircraft were allotted for full-tim duty; a communications network was set up tc distress calls; survival equipment was placed planes; and a specialized rescue-training sch established at Blackpool. This school was lat available to United States Eighth Air Force when American air sea rescue was still in i stages of organization.

Prior to the United States' entry into the wa was no comprehensive American air sea resc or program. The Coast Guard had develop of its aspects but, on the whole, purely local f were used, and the practice of diverting com surface craft in cases of forced landing at : grown up parallel with prewar aviation advan

This faint pioneering, combined with the ences of the British, served as a nucleus for the American unit. Pending the manufacture o ment and the development of air sea rescue o tion, it was necessary for the Navy in 194 assign Dumbo squadrons and VH units to resc In February 1944, the joint chiefs of staff rec the requirement and necessity for rapid joint development of air-sea rescue equipment, pro and techniques, and requested the Secretary Navy to establish in the Coast Guard the Rescue Agency to coordinate studies condu these fields by the various United States servi to maintain liaison with services of allied gover

The joint military service nature of the characterized its organization. It is headed Commandant of the Coast Guard, who is assi a board on which are represented the Ar Forces, the Army Service Forces and the Liaison with air sea rescue agencies of allied is carried on through working contacts with th sions in the United States. Liaison with the

Survivors of a ditching in the Pacific rescued by destroyer—part of the wartime rescue team.—U. photo.



ador, a Coast Guard helicopter evacuates the first of ivors of two plane crashes in the icy wilderness.— 'uard photo.

United States is maintained through liaison from the agency attached to combat theater ontier commands; through liaison officers from pective services attached to the full-time staff agency; and through agency and respective representation on Agency committees which to the head of the agency and his board on lowing subjects: (1) emergency and survival tions, (2) adequacy of air sea rescue facilities, nmunication facilities and requirements for air cue, (4) special aircraft equipment for rescue rvival, (5) lifesaving equipment on transports, edical and physiological aspects of air sea and (7) ditching procedures.

Air Sea Rescue Agency is not to be confused ie Coast Guard's Office of Air Sea Rescue. fference between them lies in the fact that he Agency is charged primarily with the col- and distribution of information concerning the development of equipment, procedures, and techniques, and coordinating studies in these fields for the benefit of United States and allied military services—the Coast Guard's air sea rescue organization is an integral part of its office of operations.

In August 1944 the commander in chief of the Navy directed sea frontier commanders to establish centralized control for air sea rescue operations, and the Coast Guard, under frontier commands, to furnish facilities and personnel for these operations. In the same months Army authorities, with the background of their ETO experience, established air sea rescue organizations at strategic points, particularly in Alaska and along Air Transport Command routes. This action was taken by the Army Air Forces while completing the organization of its air-land rescue system, with special emphasis on requirements in the western mountain regions of the United States under the Second and Fourth Air Forces.

Also, under American command, the necessity for maintaining close operational liaison with allied forces, was not without significance in the execution of plans.

Such liaison was required especially in tropical survival, communications, the protection of rescue aircraft in coordination with attacks at both long and short ranges, and coordination with expanded rescue facilities which include the use of submarines.

Air sea rescue projects were practical ones, not theoretical. The Committee to Study Special Equipment for Rescue and Survival was especially effective in achieving practical coordination through committee discussions and information exchange.

Admiral Russel R. Waesche, then Commandant of the Coast Guard and Head of Air Sea Rescue, very clearly outlined the important role air sea rescue played during the war when he said, "Our aviators and seamen, with confidence that they will fly and sail again tomorrow, dare to face greater odds in the war today. Vision of our services, and ingenuity of industry have provided survival and rescue equipment which has lessened the hazards, improved the safety, and given our men greater courage. May we never be content with present equipment, but constantly improve it with experience, continued study and cooperative effort."

As the war progressed, the research and development organizations of the Army and Navy, together with those established by Presidential directives, such as the Office of Inventions, the National Defense Research Committee and others, were instrumental in developing much new equipment which later was

Safe . . . these British merchant ship survivors climb aboard a Coast Guard rescue vessel.—Coast Guard photo.

used successfully in the field. All of the ı units cooperated wholeheartedly in the devel of equipment and worked diligently to me requirements.

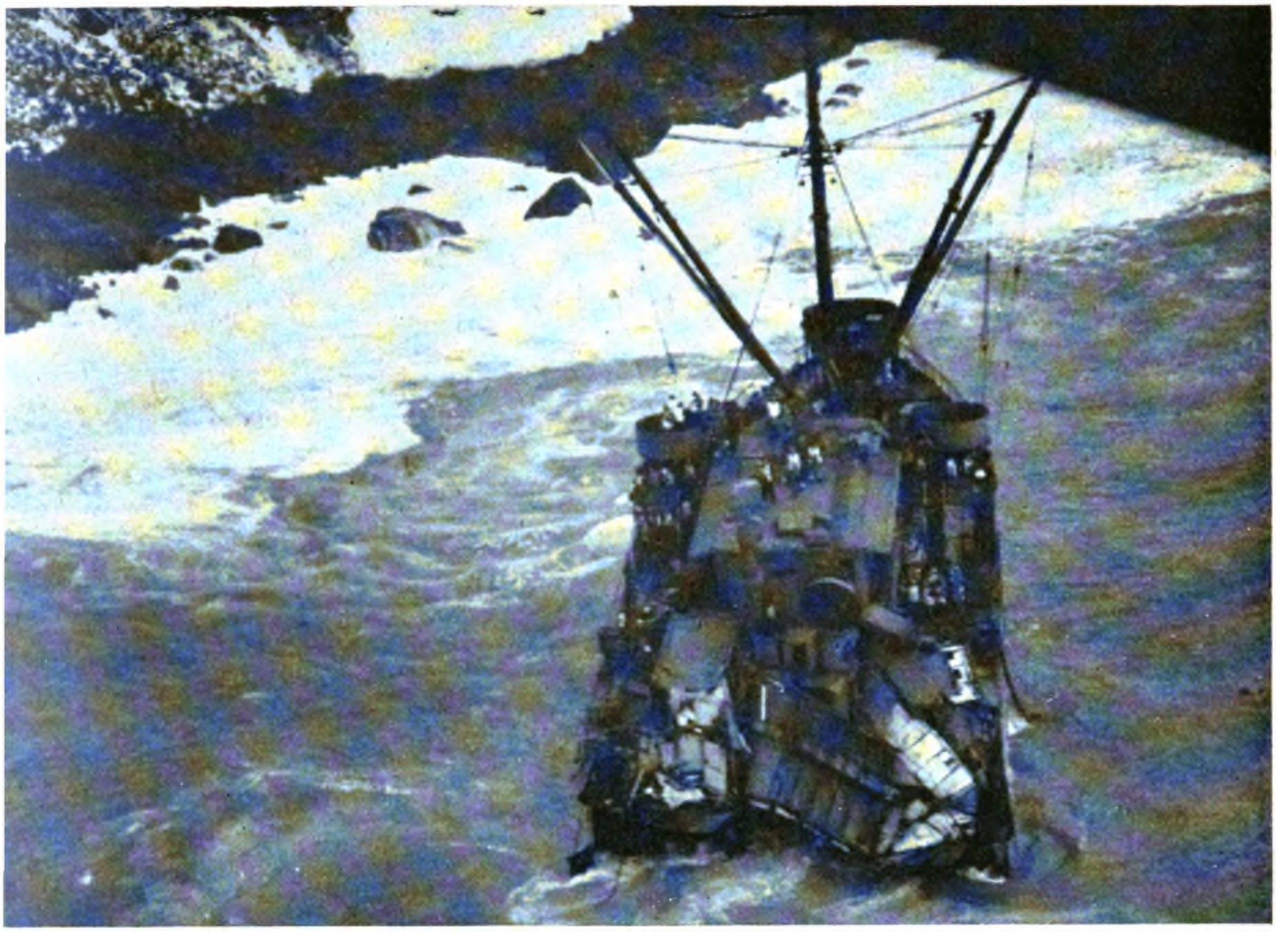
Numerous new equipment items were de and distributed. The quick-donning exposu for example, was used by fliers in multiplace to afford protection against exposure in tl regions of the world where planes flew over th In addition, there was developed a continuo exposure suit to be worn by fliers in aircraft the available space precluded donning a s exposure suit.

Sea marker dye was a war invention, and lat Mae West was equipped with two packages of protect the survivor from attacks by sharks an carnivorous fish, shark packet repellent was de and also attached to each life vest.

The various types of pneumatic rafts availabl contain the latest equipment, including such items as the hand-held day and night distress which produces a dense cloud of orange-colorec for daytime use and a brilliant flare at nig signalling mirror, which is equipped with an device, enabling the operator to direct the the sun to searching craft and thus indic position; the Very projector kit containing projector and six signal cartridges; the pyro signal pistol and six aircraft parachute flar corner reflector, which, when erected on a life boat, can be picked up by search radar; tl still, which will produce an average of 750 drinking water from sea water in an 8-hour the chemical drinking water kit, a complete which will produce approximately 5 pints of water from sea water.

Several aerial delivery kits developed by the be dropped to survivors in all areas of the wo vide virtually unlimited equipment, food, wat medical supplies to sustain survivors until tl rescued. The Navy had developed the shipw rations kit, and signaling kit for the same purp

The Gibson Girl radio (AN/CRT-3), whic matically operates alternately on 500 kilocyc 8280 kilocycles, was developed to provide a me searching aircraft and surface vessels to home position of the survivor. This radio, packe waterproof buoyant case, by means of a pa may be dropped from an aircraft to the survivo Gibson Girl is carried in multiplace aircraft w can easily be placed in a life raft when the



Wreck of the Yukon near Seward, Alaska. Search and rescue teams saved many lives in this recent disaster.—Army Air Forces photo.

›ned. The Air Sea Rescue Equipment Guide, ıed by the ASR Agency in February 1945, lists ›,000 items. Since that time many more have dded and the evaluation and improvement of ›d articles is a continual process. All these were developed through the coordination of Navy, Coast Guard, and Marine Corps es and personnel.

ipment was not enough. Pilots and crew had rained to use it. Operational training centers schools approximating as nearly as possible arctic, or open-water conditions. Courses lesigned to teach the basic principles of living land and sea, principles which might be apn any part of the world. Emphasis was placed individual survival and consisted of informand instruction of techniques and skills which men to survive with a minimum of emergency ntil rescued.

fundamentals taught include:

Travel in all types of terrain.

(*b*) Orientation to their situation.

(*c*) Collection and identification of plant and animal food.

(*d*) Location of water and water substitutes.

(*e*) Construction of shelters.

(*f*) Preparation of food, including firemaking and cooking.

(*g*) Knowledge of the biological and physical hazards in the area in which the training is given, and the relationship of these hazards with similar ones in other parts of the world.

To these fundamentals were added the operation of emergency rescue equipment, procedures of ditching aircraft and bailing out, techniques of water survival, adapted skills of hand-to-hand combat and gymnastics, methods of communicating with rescue units and precautionary measures and medical treatment for typical ailments. That these weeks of vigorous training paid off, is shown in the number of men who, when faced with the real thing, lived to fly, sail, and fight again.

Operating methods and techniques were also revised to keep pace with the expansion in transoceanic flying. The function of weather ships, for instance, was enlarged. No longer was theirs merely a job of reporting the weather—they became radio beacons and, when necessary, rescue vessels. They became part of a vast network of stations strategically located in the Atlantic and Pacific. Extensive telecommunications networks were established—utilizing radio, radar, loran. New concepts of coordination and teamwork became the order of the day.

The value of all this research, testing, training and revision is pointed up in the remarks of Capt. Eddie Rickenbacker who, speaking of his own dramatic experience of ditching and survival in an earlier edition of the AIR SEA RESCUE BULLETIN, said, "The story of my own experience as a survivor would have been stripped of much of its aura of stark tragedy had it occurred a year later than it did. Perhaps then, instead of 'seven came through,' it would have been eight. We would not have known thirst. The drinking water kit which converts salt water into fresh water in a matter of minutes, or the solar still, which uses the energy of the sun to produce more than a pint of fresh water a day, would have obviated that. We would not have experienced the terrible hunger, had we possessed the compact, concentrated food kits with which every rubber life raft is equipped today. Nor would we have suffered the exhaustive drain on our physical strength had our raft contained some of the anti-exposure equi carried today.

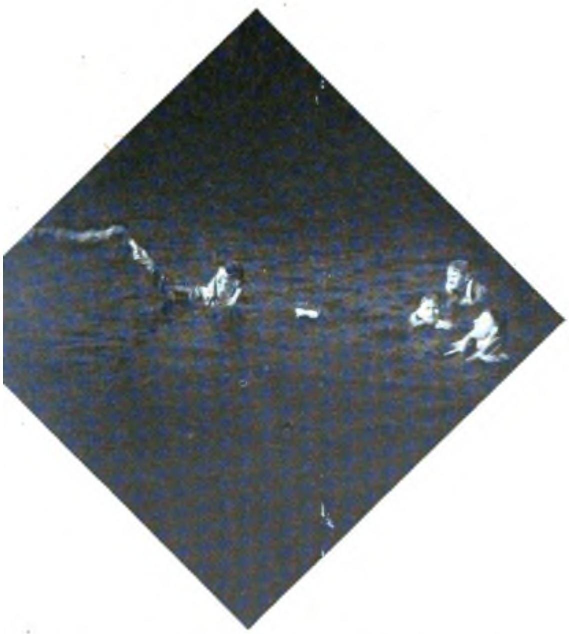
"We would not have felt the terrifying anguish caused by the fear of 'when' or 'hov if we had known, as every airman knows toda rescue would be but a matter of minutes, or h most, instead of days and weeks as it wa us . . . or had we the peace of mind engende the knowledge of the intricate and efficient tional pattern of planes, ships and men, radio, and all the rest, which comprise air sea rescue And added to all these, the knowledge that rescue did come it would find us fit, that all to do was to keep cool and virtually 'sit it out brief spell in comparative comfort."

The record of lives saved is adequate testim the success and efficiency of air sea rescue uni the Pacific, from Pearl Harbor to VJ-day, mo 3,000 airmen of the United States and Allie tions were saved. In the continental United area in the period from January 1945 to and inc March 1946, 1,032 were saved. Breaking these down still further, we find that our West coast saved 192 men in 16 months, another saved 9 months, and in one 12-month period, 452 were in the Eastern Sea Frontier area.

Since its inception against a background c air sea rescue has experienced an evolution in m and techniques. Its wartime conception was upon the urgency of saving men and mach

Yukon survivors take a last look at their battered vessel as they pull away to safety.—Photo: Oliver Cromwell, RM3c,

Jungle or arctic . . . the rescue team is trained to operate efficiently in any type of terrain.—Marine Corps photo.



e orange-colored smoke flares help locate survivors one of many important pyrotechnic developments in -U. S. Navy photo.

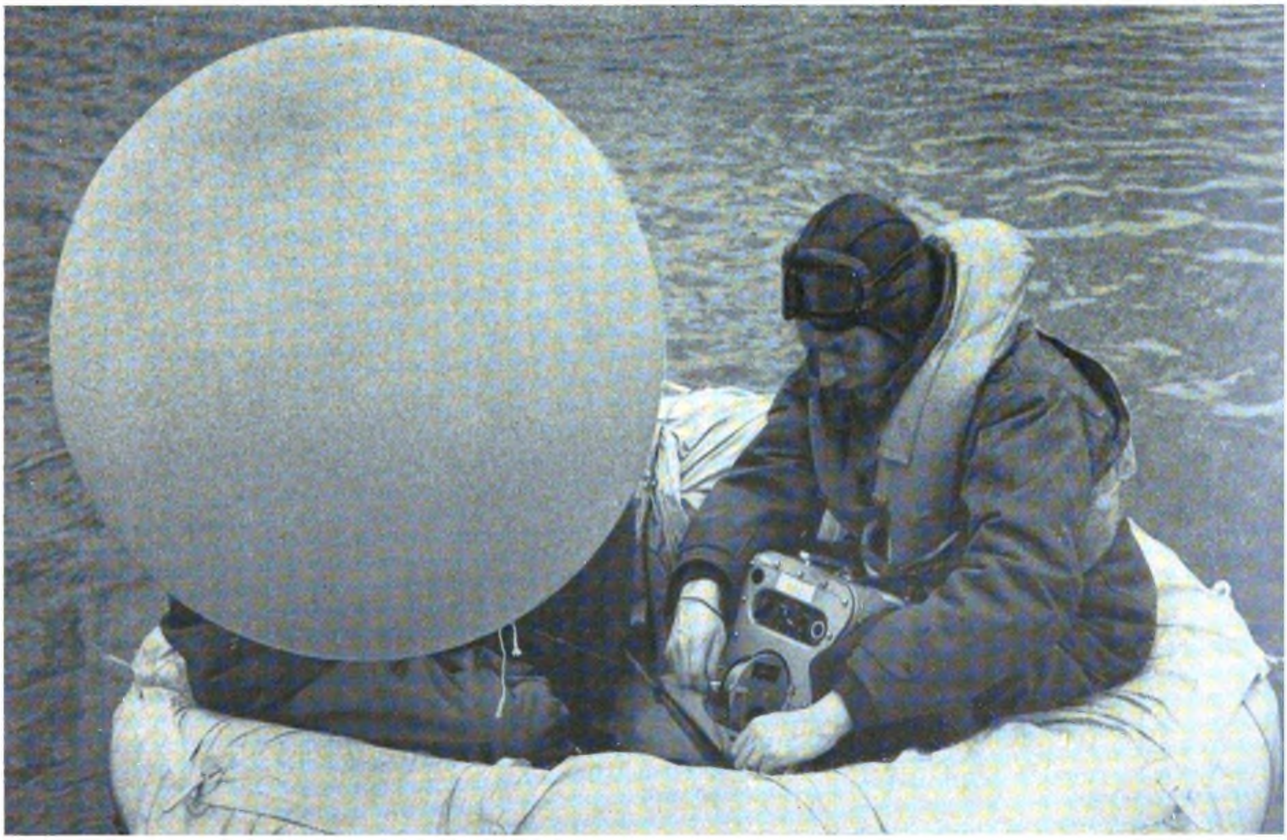
carry on the fight . . . it operated in more or less concentrated areas, using all available military facilities such as short range aircraft and boats, destroyers, submarines. In five short years it has witnessed an amazing refinement in methods and equipment. It has acquired a "know how" based on experience which has patterned its operation on an international plane in keeping with the Nation's future program of aviation and maritime development. Today it is a vast efficient network which includes the use of long range planes and surface craft; a well organized communications system utilizing radio, radar, racon, and loran; a comprehensive pattern of ocean station vessels performing an invaluable weather reporting and safety function; and an extensive system of rescue coordination centers which tie the whole together and directs the movement of the air sea rescue team.

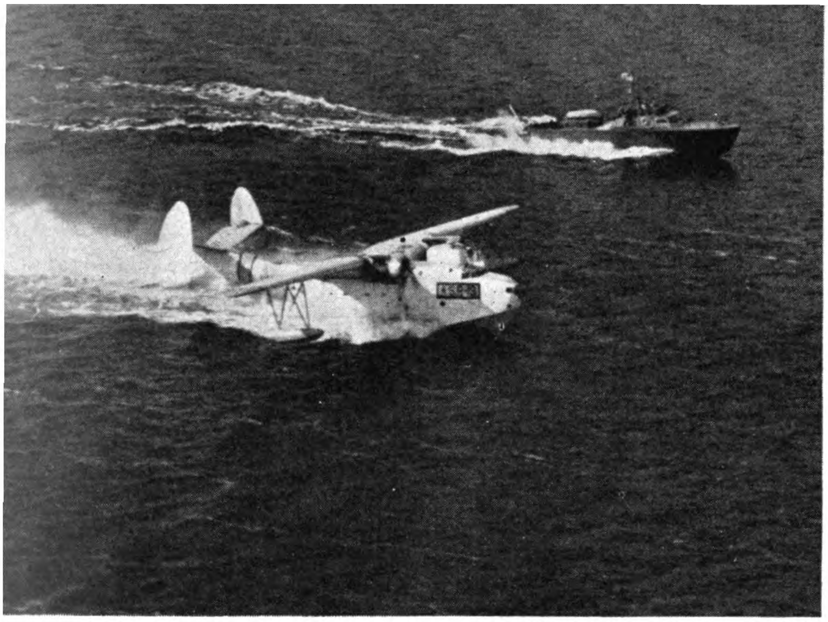
Practically all of the nations of the world are including the subject of search and rescue in their diplomatic and commercial discussions . . . not alone

Signaling mirrors saved many lives by attracting the attention of rescue craft.—Coast Guard photo.

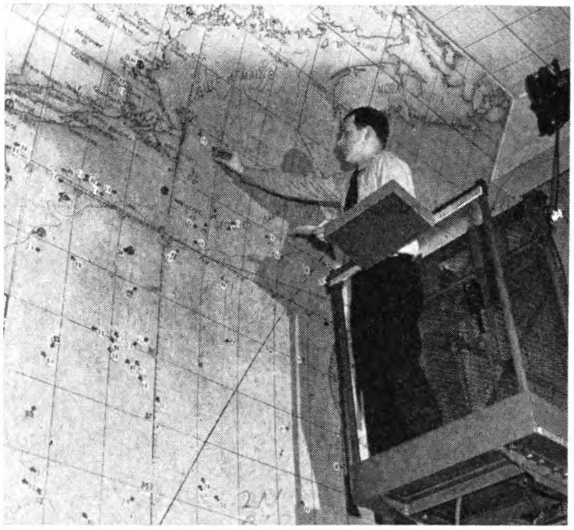
All-weather exposure suits saved many lives by pro against cold while providing buoyancy and freedom of ment.—Coast Guard photo.

RCAF flyer gets ready to hoist antenna-raising balloon of his Gibson Girl automatic emergency transmitter.—RCAF



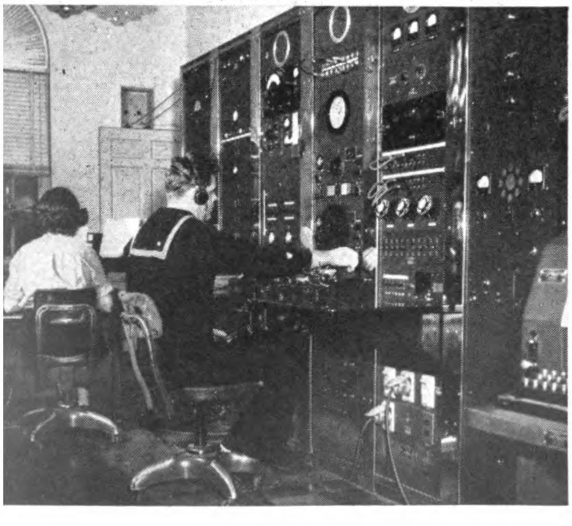


The search and rescue team—a Coast Guard PBY-6A and an Army 85-footer—heads seaward on a rescue mission.—Coast Guard photo.



Control Center keeps accurate track of position aircraft and vessels in area.—Coast Guard photo.

ımunications—radio, radar, loran—are the heart of ch and rescue control system.—Coast Guard photo.



because it represents an invaluable contribution to the safety of travel on land and sea, but because it provides an important instrument with which to improve friendliness between nations. Nations at peace are ever willing to help alleviate the misfortunes of their neighbors as a gesture of humanitarianism and good will.

It is just a little more than a year since the nations of the world met at Chicago to discuss what cooperative means could be found for developing international civil aviation for the benefit of mankind . . . and just a few months ago the instrument created by those nations, the Provisional International Civil Aviation Organization (PICAO), began to work for the amicable, equitable and orderly development of international air traffic in all its phases.

In broad terms, PICAO has three basic objectives: (1) to create the best physical conditions for civil flying, to eliminate the hazards that arise from a lack of proper organization of air routes or from failure to reach agreement on proper organization; (2) to free international flying from any obstruction or delay of a legal nature; (3) to make international air transport an instrument of good will rather than suspicion and conflict.

The Search and Rescue subcommittee of PICAO is developing a suggested program for the nations of the world in developing the rescue services of the world into a globe-encompassing network that would save many victims of air crashes in remote places along the world's air lanes. It submitted a report of standards it believed necessary for international search and rescue operations. It recognized that while the wartime experience is by no means a fair criterion to apply to commercial aviation, the record of the war-

time years in saving life indicates the importance of having an organized plan for rescue work in advance of the time when the emergency arises. Such emergencies are fortunately rare in civil flying, but civil aviation authorities can nevertheless learn the value of preparedness from the military experience.

The mission of search and rescue is a joint responsibility of all nations and peoples. Further, it is a team effort . . . an operation which, at one time or another, will call upon every type of vessel and plane, plus the ingenuity and initiative of groups and individuals, to assure success.

The merchant ships that ply their trade across the Atlantic and Pacific are part of this vast plan of coordinated search and rescue. Their positions are plotted daily at the naval sea frontier control centers . . . and in keeping with honored traditions of the sea, they stand ready to answer calls for aid from planes or ships in their vicinity. Their logs today contain records of hundreds of successfully accomplished rescue missions.

The scope of peacetime search and rescue widens as world airlines increase the frequency of their transoceanic flights. The resumption of peacetime maritime pursuits, and the development of private flying also step up the ratio of possible emergency incidents.

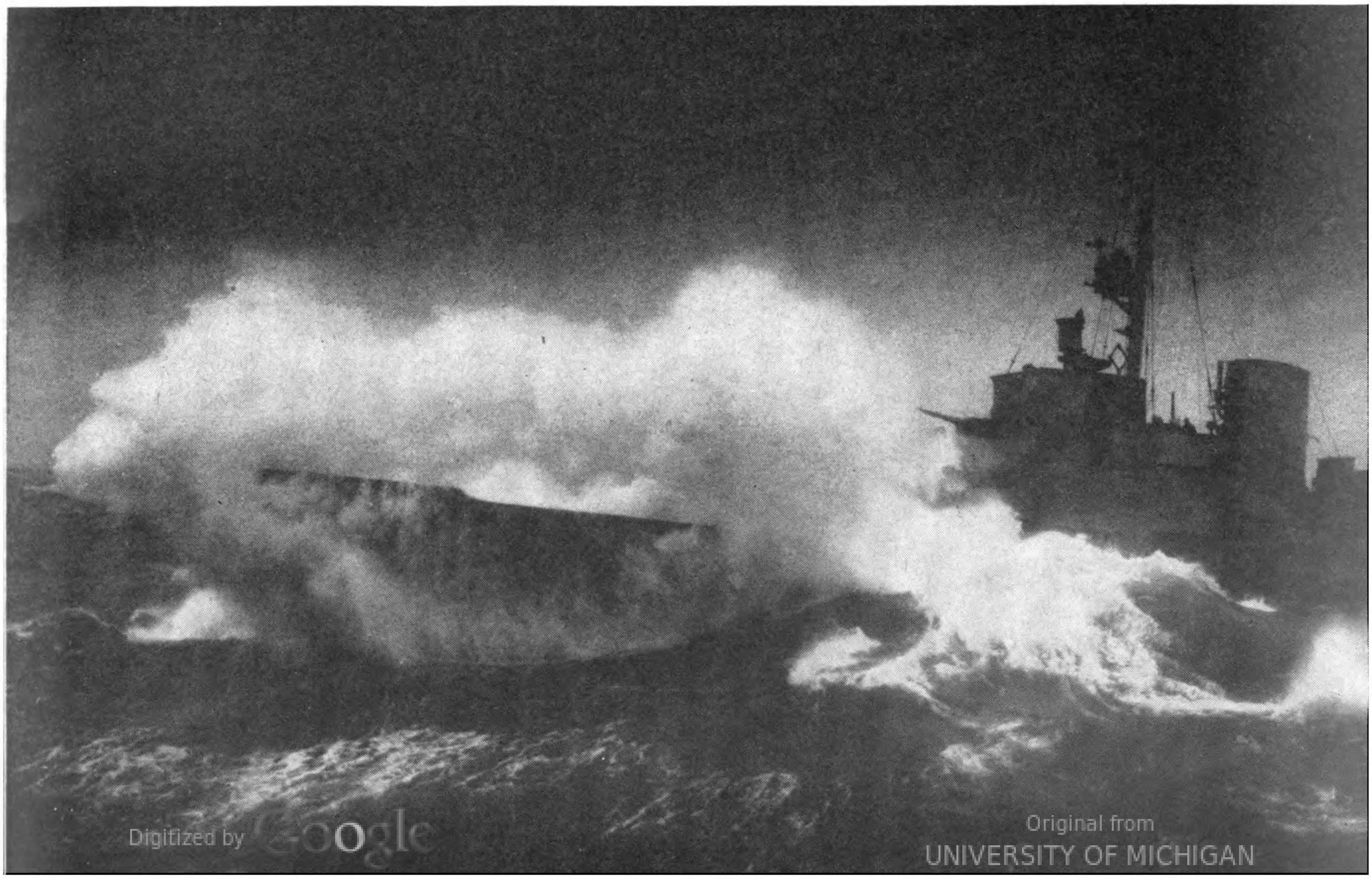
In spite of man-made safety measures, mechanical failures, floods, and storms will continue to be hazards for the traveler on land or sea. Wartime expe in search and rescue, however, point the greater safety and will stimulate confidence on larger pattern than ever before.

* * * *

It will be noted that the term "air sea rescu "search and rescue" are both used in this The former—air sea rescue—is a term conce war and applied to the rescue of survivors fro dents peculiar to military operations—especial bat operations. Further, while the orders and tions plans of military commanders stipulated t was also to be extended to the survivors of s ship disasters, the term was too frequently inte to apply to airmen only.

Thus PICAO, in quest of a more definitiv adopted "search and rescue." At its North A Route Service conference in Dublin, it was mended that the term be defined as . . . "T of finding and returning to safety the survivo an emergency incident." This definition i ciently broad to embrace the rendering of survivors of civil and military aircraft and shi and where aircraft are involved, it will apply or at sea.

A Coast Guard weather ship "rides it out" on stat heavy sea.—Coast Guard photo.



handie talkie

(VHF Emergency Transmitter-Receiver, AN/CRC–7)

the unit held in vertical for use.

FOR some time a definite requirement has existed for a compact, lightweight, portable transmitter which could be stowed in an aircraft or in life rafts, and which could be used handily by survivors of an emergency to assist in their rescue. The AN/CRC–7, which was recently adopted by the Army and Navy, is believed to satisfy the basic requirements for such a unit. The AN/CRC–7 is designed to provide tone and voice transmission, voice reception, and a homing beacon. The transmission and reception of signals will provide for communications between survivor and the rescue craft; and tone transmission—employed as a homing beacon—will assist the rescue units to locate the survivor.

Operating on a single crystal-controlled frequency of 140.58 mcs., the AN/CRC–7 is capable of tone transmission in line-of-sight up to 45 miles when received by Army and Navy standard VHF sets SCR–522, AN/ARC–1, or AN/ARC–3. Voice reception of these same sets, as transmitters, is up to full line-of-sight if the transmitter power is adequate. Again, the accuracy of homing on the AN/CRC–7 is dependent only on the homing device which is used.

The AN/CRC–7 is 15 inches long, 2¼ inches in diameter and weighs 3 pounds 12 ounces. When in use, the antenna is extendable to 21⅜ inches.

A combination microphone and speaker is employed, and the switch section and main body are hermetically sealed. The battery compartment is completely watertight.

One of the most desirable features of the 140.58 mcs. frequency is that it is above the atmospheric and precipitation static regions, and is generally unaffected by weather conditions. Extremely high frequencies, however, will not penetrate jungle growth very well. They are also masked by hills, high ocean waves or other obstructions in a manner similar to that of visible light waves.

Tests conducted by the Army Air Forces at Narragansett Bay give pretty fair indication of the possibilities inherent in the AN/CRC–7. A crash boat took position off Rocky Point in Narragansett Bay with two of these radio sets aboard, and a C–47 took off from Quonset NAS with the remainder of the test group party. Two-way communication was immediately established between the SCR–522 VHF set in the aircraft and the AN/CRC–7 in the boat.

The following conclusions were reached as a result of the tests outlined above:

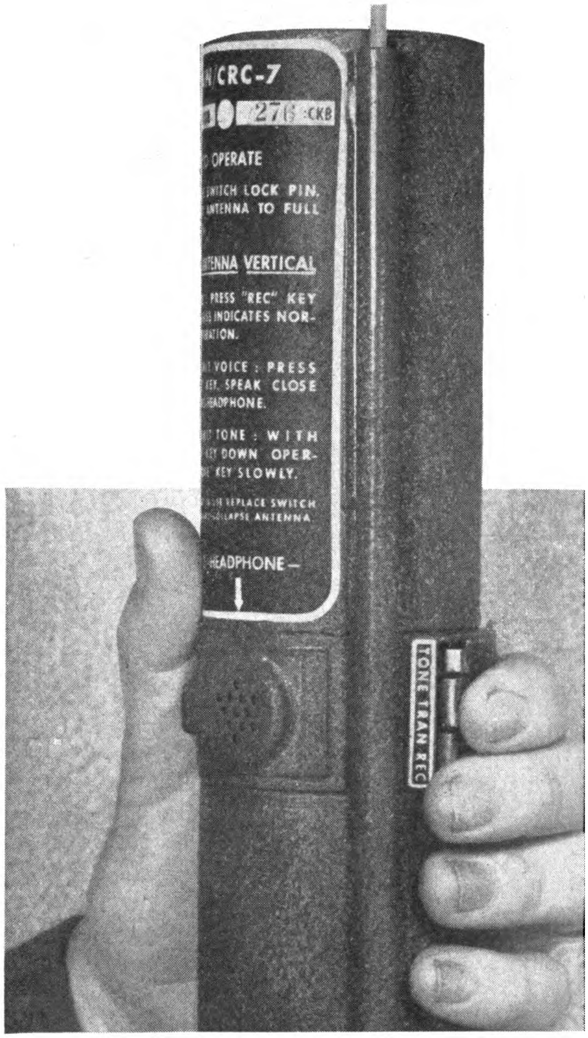
1. That an aircraft equipped with the SCR–522, or equal, and the AN/ARA–8 homing adapter, can home on the AN/CRC–7 signal from a distance of approximately 40 miles.

2. The AN/CRC–7 antenna should be held at, or near, the vertical to assure the best signal reception.

3. The voice level during thunderstorms was found to be high. To reduce it, the tone oscillator of the AN/CRC–7 might be accurately adjusted to 1020 cycles per second, and the range filter used on the receiving SCR–522. Since the use of the range filter may reduce the maximum distance at which the AN/CRC–7 can be received, the filter should not be used until after initial contact has been established.

An aircraft-type life raft was then launched and placed in position several hundred feet from the crash boat. The occupant of the life raft carried an AN/CRC–7. Then, using the AN/ARA–8 VHF homing adopter, the C–47 homed on the signal in such

The AN/CRC–7 and its canvas carrying case.



Close-up showing microphone and operating controls.

a manner as to pass over the life raft. The then proceeded toward Boston in order to dete the maximum range of the set. With the C– 10,000 feet altitude the signal was lost at abc miles. Most of the transmission during this] was over land. After losing the signal, the C–4 ceeded at 10,000 feet to a distance of approxir 120 miles before reversing its course. Comm tion was not reestablished until the C–47 had re the approximate position where the signal hac lost. Homing on the signal was repeated, thi: the AN/CRC–7 being operated from the crash

On the return trip, the ceiling was approxi 1,000 feet and the visibility in the order of : miles. It would have been extremely difficult f pilot to have located the crash boat by visual because he did not know its exact position. S homing passes were made from distances of : miles from the boat with the AN/CRC–7 in v positions.

Angry seas pound the beach at Hilo.—U. S. Navy photo.

)AL WAVE HITS HAWAII . . . this was ɩe flashing headline that blazed across the front ɪf the Nation's newspapers on 1 April 1946. As :ase in any situation involving a people in dis- ɪe news struck an immediately responsive chord ɪearts of the American people. Yet, almost as as it happened, the emergency was over . . . persons thousands of miles from the scene, it : but a brief interlude in a fast-moving pano- ɪf many important events.

to the people of Hawaii, the first terrifying im- ɪd the events which followed, remain a moving f tragedy, quiet courage, and an awesome re- 'or the overwhelming forces of nature on a ;e.

personnel of air sea rescue task units in , however, it was even more. Here was the training and organization—slammed on their p with the speed and force of a battering ram. as IT—now. No time to refer to the book—no pore over charts—no time to "get set." Here's t paid off with the calm, quiet confidence born ›wing how"—or missed.

here was no miss. Hidden in the prosaic, stud- ›orts of the rescue operations lie the answer sound training, painstaking organization, good ne, high morale.

first indication that a tidal wave had struck the an Islands, came to the Hawaiian Sea Fron- R Control Center when, at 0651, the Haleiwa Boat Basin reported that two of its 85-foot ɪad been badly damaged by heavy surf. A ›ments later, the rescue unit at NAS Kaneohe d a small building had been swept off the to sea by towering waves. The rescue con- immediately ordered all ready rescue aircraft : air to comb and investigate the Oahu Beach Their reports indicated that the entire northern coastline of Oahu, from Kaena Point on the west, to Koko Head on the southeast had already suffered varying degrees of damage, and that the situation required that major rescue operations get under way immediately.

At 0809 on 1 April, all available rescue craft—air and surface—were dispatched to search the surrounding waters and bays. Johnston, Midway, French Frigate, and Palmyra Islands were alerted to the threat of the approaching tidal wave. Seagoing patrol craft were dispatched to assist in rescue operations off the northern Oahu Beach area. One PBY from ASR Task Unit No. 2 was stationed 200 miles northeast of Oahu to provide advance warning of possible additional incoming waves. Because communication with French Frigate Shoals and Molakai Island were out, another PBY was dispatched to investigate the situation at French Frigate, and a B–17 from the Seventh Emergency Rescue Squadron went to Molokai with instructions to pay particular attention to the Leper Colony on the north shore.

In spite of considerable damage to rescue craft, the reports which came into the control center at 1030 from rescue units at Kahului, Maui, and Hilo indicated that rescue operations were proceeding smoothly. In response to Hilo's request for additional assistance, two PC boats were dispatched by Hawaiian Sea Frontier, a PBY was dispatched by ASR Task Unit No. 2, and a B–17 with droppable lifeboat, by the Seventh Emergency Rescue Squadron.

By sunset, the entire beach area of Oahu, and for 10 miles out to sea, had been thoroughly searched by air and surface craft and all but one missing person accounted for. Arrangements were made to send three utility wing aircraft and two from ASR Task Unit No. 2 to Hilo at dawn next morning to implement the rescue facilities there. Hawaiian Sea Fron-

tier also put into operation a rotation plan for maintaining two fully-operational PC boats at Hilo, and one at Kahului, Maui.

On 2 April rescue operations in the Oahu area were centered on the immediate beach and along the drift line from Kaena Point in an effort to find the one person unaccounted for on the previous day. An intensive air-surface search was also conducted by ASR Task Unit No. 4 along the northern coast of Hawaii.

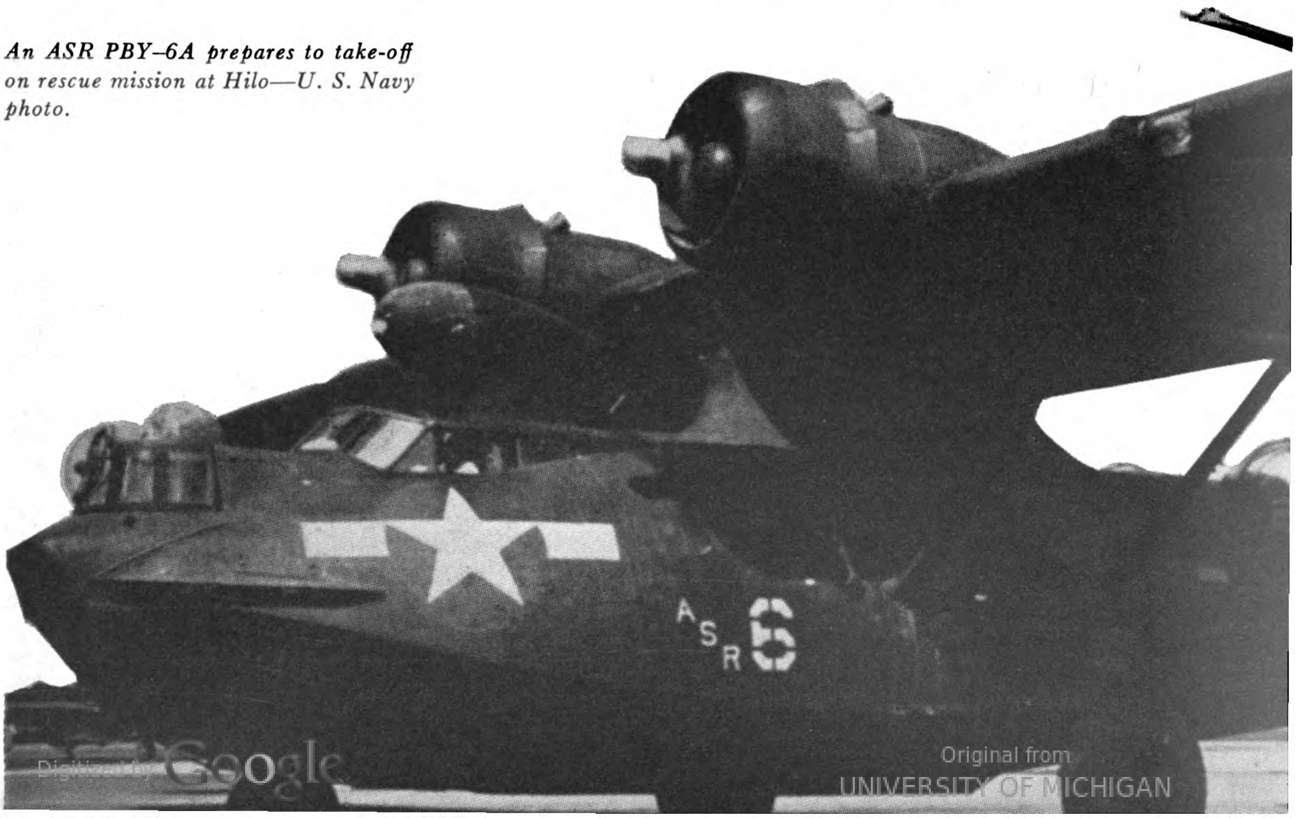
Rescue operations on 3 April followed the same pattern as that of the previous day and at dusk, except for purely local rescue activities, the search was concluded.

In the period from 0731 on 1 April to 1800 on the 3d, a total of 515 hours were flown by rescue aircraft. Air and surface craft combined, saved more than 150 persons from almost certain death, and aided an undetermined number of others. One 63-foot rescue craft was lost, another damaged beyond repair. Five others were damaged in varying degrees. A PBY–5A was lost in heavy seas after an open sea landing. Personnel casualties were 2 men slightly injured.

This entire operation was a cooperative effort by the forces of the Hawaiian Sea Frontier, Utility Wing, Seventh Emergency Rescue Squadron, LST–731, and cordinated rescue units. It was a completely successful operation. The final sentence of the official report is prosaic enough. It reads . . . "All participating units exhibited a high degree of skill and cooperative spirit throughout the entire operation."

ASR personnel load a PBY–6A with liferafts prior t off at Hilo—U. S. Navy photo.

An ASR PBY–6A prepares to take-off on rescue mission at Hilo—U. S. Navy photo.



Front view of chest-type harness.

Showing two lower points of adjustment.

vy quick-fit chest type parachute harness

ɪYING personnel will be interested in the new Navy quick-fit, chest-type parachute harness. ɜrs from the Navy standard harness now in use t the adapters have been deleted from the leg and the old type snap and **V** ring have been ɜd by snap and **V** ring with quick-fit adapters. he backstrap has been made into a separate terminating at each end in a friction adapter h which the chest straps are reeved. These traps terminate at the side of the body just be- e ribs.

ɪ intended that the Navy quick-fit, chest-type ɪute and harness will be left in the airplane at all he airplane is ready for flight operations. The ɪute harness shall be adjusted to its full capacity airplane captain or parachute rigger as soon as laced in the airplane or after every landing. ɪ accomplished by holding the snap, **V** ring, or ɜr at right angles to the webbing and pulling rdware.

ɪt personnel should don and adjust the para- ɪarness immediately after boarding the airplane. are four points of adjustment, one on each leg nd one on each side of the body located approxi- at the lower rib. All adjustments are made by hand. No tools are required. Procedure for donning and adjustment of the harness is as follows:

(*a*) Don the parachute harness in the usual manner.

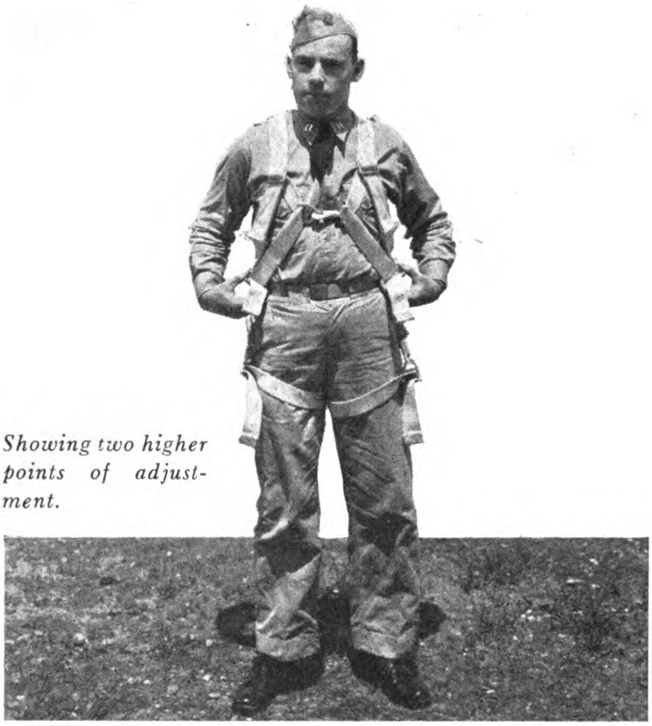
(*b*) Hook up the chest straps and leg straps.

(*c*) Pull the leg strap tab ends downward until a suitable snug fit is obtained.

(*d*) Pull diagonally upwards on the chest strap tab ends, until a suitably snug fit is obtained. This operation removes all slack from the chest and back straps and removes any remaining slack from the shoulder straps.

(*e*) If desired, the loose tab ends of the chest and leg straps may be tucked under.

The harness may be loosened for comfort during flight if desired. This is accomplished by tilting at right angles to the webbing the snap and **V** ring on the leg straps and the adapters on the backstraps and pulling thereon. Do not unsnap the harness attachments. It is emphasized that there may be insufficient time during emergencies to properly readjust the harness prior to bail-out. For this reason, loosening the harness should be kept to a minimum and it should never be loosened to its full capacity. Serious injury may result to flight personnel bailing out with harness fitted too loosely.



Showing two higher points of adjustment.

The quick-fit hardware operates on the friction lock principle. When pull away from the hardware is exerted, the sliding bar, around which the harness webbing is reeved, moves to the rear of the hardware, locking the webbing between the sliding bar and rear bar of the hardware. The quick fit hardware has been dummy-drop tested and live jumped and has successfully passed all requirements.

Since the quick fit chest type parachute harness must remain adjustable at all times in order to properly fit both large and small flight personnel, temporary tacking to the parachute harness, which will restrict adjustability, must not be used. The only position on the harness which may be tacked is the chest snap and **V** ring. It has been determined that by tacking the chest snap and **V** ring on and body straps 6 inches below the fixed shoulder adapters that a position to properly fit all size personnel is obtained.

Procurement of quick-fit hardware has been initiated and deliveries of this parachute harness is anticipated during the second quarter of 1946.

Particularly valuable to Personal Equipment Officers, is the Air Forces' new *Reference Manual for Personal Equipment Officers* (*AAF Manual 55–0–1*). Prepared by the Personal Equipment Laboratory, Wright Field, it is a practical reference manual sufficiently broad in scope to be of interest to all military flying personnel.

POLE LITTER CARRYING STR

From the Naval Medical Research Institute the design for a simple, inexpensive strap for h litter bearers to carry their burden more easi is a cotton tape 1/16-inch thick by 1½ inche by 98 inches long. In the absence of such m the tape can be made of a strip of canvas 6¼ wide by 98 inches long. The canvas is folde four thicknesses and sewn. In making the ca straps from either the manufactured tape or strap, the following steps are taken:

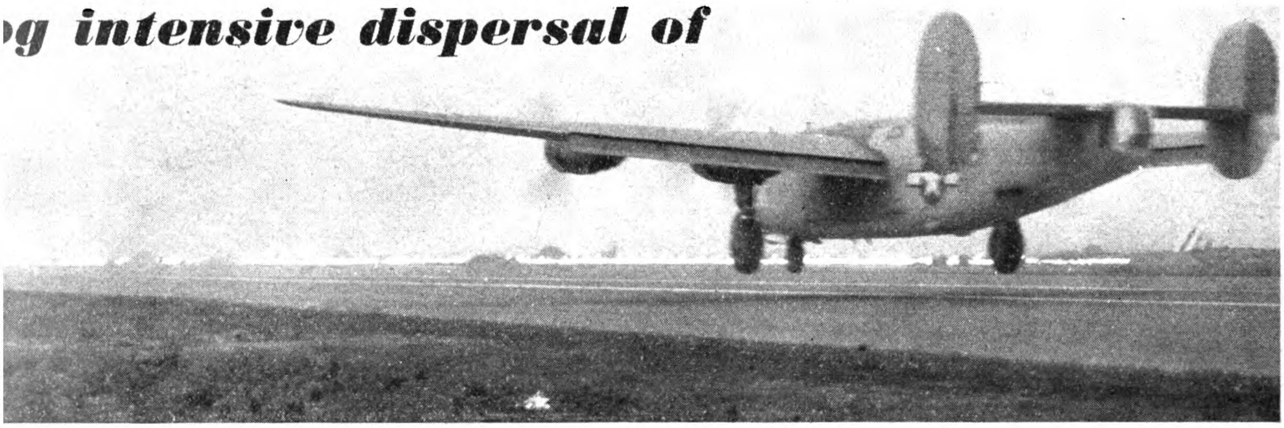
1. Make a single loop on one end by foldin 6¾ inches and sewing down 2¼ inches. This a loop of 4½ inches.
2. On the opposite end fold back a loop inches and sew down 2¼ inches. Sew down 1 inch sections. This leaves four loops of 4½ each. Hot wax can be applied over the sew faces if desired. This will seal the stitchin prevent the 1 inch sections from absorbing wa

This strap is not designed to supplant the the arms in carrying the litter, but to afford the a chance to rest his arms completely or to t least a part of the litter weight off his arm rough terrain the weight can be borne by the thus leaving the hands free to allow the bea balance himself better and steady the patient litter.

The four loops in one end of the strap eli the use of metal buckles and fasteners that wou to deteriorate in moist climates, and allow the to fit rapidly the handles in a loop commen with his arm length. The straps are light and i and can be carried in the pocket or belt wh being used.

FIDO

›g intensive dispersal of



ınder Robert L. Champion, the Navy's No. 1 expert on trol, is a 32-year-old ex-engineer turned sailor. Grad- the University of Illinois, and a former instructor in ıics at Northwestern University, Champion discovered atomizing gasoline before burning it, he could cut a fog blanket 3 feet thick in 10 minutes. It all when he was stationed on Attu and had to devise a planes to land on islands which were covered by fog e months of the year. Commercially practicable, his method will soon be available to the world's commercial air lines. Champion's most exciting experience took place while ferrying the late President Roosevelt to Adak in the Aleutians. A thicker fog than usual blanketed the islands and bothered the antisubmarine patrol planes which were on hand to see that the President's ship was not torpedoed. However, Champion's fog dispersal equipment performed perfectly and the President got safely through.—Ed.

spite of the magic fingers of radar and other ectronic aids, fog continues to be the airman's enemy. Being the foggiest naval air station in ıntry would ordinarily be a liability rather than ͅt, but NAS ARCATA has capitalized on its feature and become the center of a highly ant experimental program of fog dispersal.

ARCATA is situated about 300 miles north Francisco on a bluff rising abruptly 200 feet ıe ocean—a situation which contributes to the ıcidence of fog over its runways. Since other were satisfactory, and the fog was certainly le—thick, juicy, dependable fog—this station ected by the Navy in late 1944 as the Landing xperiment Station for continuing the fog-dis- work pioneered by the British and first used United States in the Aleutian Islands area.

O—meaning Fog, Intensive Dispersal of— its value in the British Isles during the war despite soupy weather, fog-bound fields were to permit the take-off and landing of bombing missions. Through holes cleared by the heat from gasoline burners outlining the runways, hundreds of bombers which might otherwise have been lost were brought down safely. The cost of the gasoline burned—$4,000 to $5,000 to land one plane—was heavy, but well spent. In fact, FIDO became so valuable in landing bombers returning from missions over Germany that at least 15 bomber command fields were equipped with fog dispersal systems.

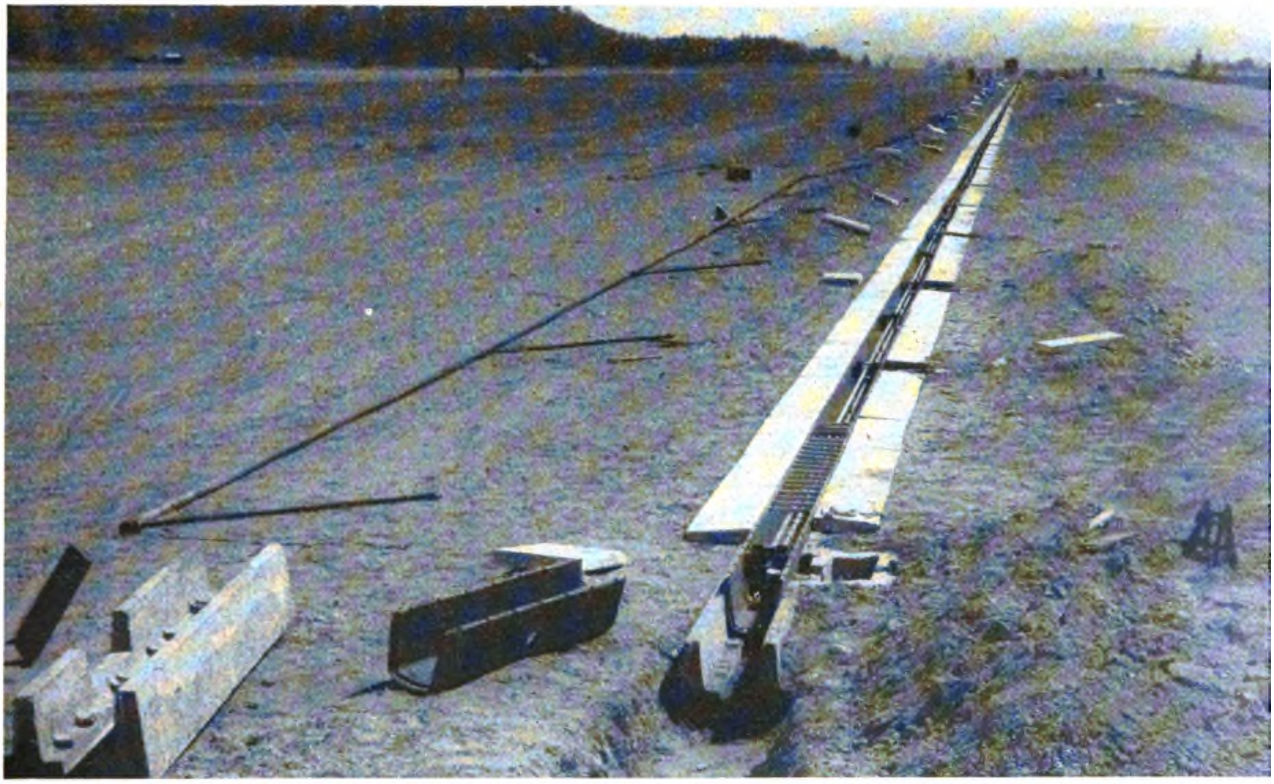
The Navy's interst in the system was primarily centered in the possibilities for its use in the Aleutians area where bad fogs prevail in conjunction with moderate to high wind conditions. Following a survey of all military fields in the area, it was decided to make the first installation on the Army Air Base at Amchitka. Work was started on the project early in 1944, with Seabee personnel installing the equipment. The nature of the terrain posed many tough problems. Enormous amounts of tundra had to be moved to provide the burners with a firm, level foundation. It was necessary to drive special supports through the tundra

to rock strata in order to carry the burners over small ponds and uneven ground. The burners, which were based principally on British design, were constructed on the site—100 of them being turned out in a brief 5-day period.

The first aircraft landing to test the FIDO installation at Amchitka under zero-zero conditions, took place in July 1944. Burners were lighted just before dawn, and within about 10 minutes the area over the runway and downwind of the burners was completely cleared of fog and the sky was visible. Taking off in a 15-mile crosswind, a PBY–5A took off and disappeared in the fog after passing the limits of the burner line. The plane then made a normal instrument letdown, and broke out in the clear at about 150-foot altitude at the downwind end of the runway. This operation was followed by two successful take-offs and landings by an Army C–47. Both pilots agreed that the landings could not have been made without the use of the fog dispersal equipment.

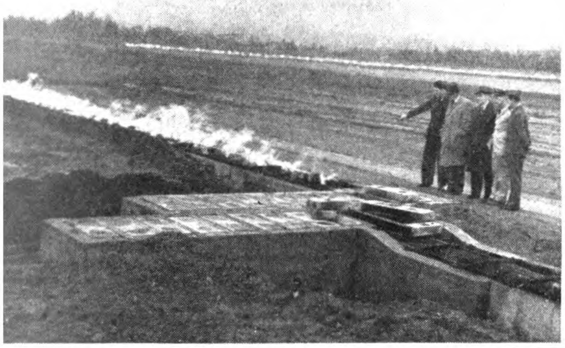
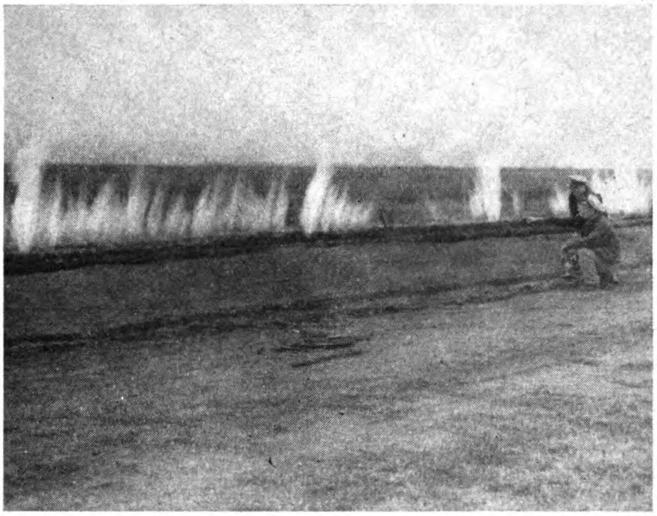
In the fall of 1944, the equipment at Amchitka was used tactically for the first time when, in spite of the heavy fog prevailing at the time, six planes were launched, with FIDO's aid, in order to form an anti-submarine screen for President Roosevelt who was then in the Adak area.

Although the cost of operating the FIDO ment, as used in the British and Amchitka instal was insignificant when evaluated against the cre aircraft which might have been lost under ze conditions without it, much remained to be d refine the equipment and to develop better efficiency to cut the expense of fuel. The ba portance of the project warranted further experi work, both on different types of burners, and dispersal methods other than thermal. This n sulted in the establishment of the Landing Aids imental Station at Arcata.



Slot-type burner which gives 10-minute burn on 2,500 gallons of gas.

When this station was first set up, the w still in progress, and the immediate aim was to the best possible equipment for fog dispersal stallation on the islands north of Japan to as aircraft operations in that area. With the wa ure removed, experimental work was continued is significant that progress of the program h watched and participated in by the Army Air Royal Air Force, British Petroleum Warfare ment, Royal Canadian Air Force, the Natio velopment and Research Committee, the Aeronautics Administration, and many leadi versities who have contributed through projects.

Different types of burners tested at Arcata to obtain most effective clearance at lowest cost.

dispersal of fog over airfields is obviously of nportance to military and commercial aircraft ons. The earlier problems of economical op- is rapidly being eliminated. So much so that mated planes can presently be landed on fog- d fields at a cost of from $100 to $200, figuring utes per plane and, at a busy airport with a traffic flow, costs can be reduced still further.

job of thoroughly developing and testing low- y landing aids calls for a wide variety of re- and installation at the experimental station. om the thermal systems which form the back- the work, the field is also equipped to test ther landing aids; sonic, wind curtain, water high-intensity lighting, radio.

most of the fog dispersal systems based on the ethod were pioneered by the British, it was de- install the most effective of these at Arcata as a yardstick for evaluating new equipment levelopment by various agencies.

mal installations include the "slot" burner, one atest designs used operationally by the British, installed at a commercial field near London. es-Rapex installation, providing the highest output of any burner system, is also in opera- is a modified Haigill system using Navy, Army ces, and British experimental designs.

"slot" type burner (USN MK-5) consists of nch pipes, one above the other a few inches Gasoline feeds through the top and, at the he line, makes a **U**-turn back into the bottom The lower pipe is drilled with regularly spaced hrough which gasoline feeds out and burns. eats the gasoline above until it becomes a vapor and creates pressure. In a few minutes enough pressure is produced to shoot flames about the height of a man. Fuel consumption for 10 minutes of operation is 2,500 gallons of 60-octane gasoline at a cost of 6.7 cents per gallon.

The Hades-Rapex burner (USN MK-3) has 16 vaporizing tubes feeding into a collecting pot. From this pot the gasoline vapor is fed into a single 8-inch burner pipe, under intense pressure. When ignited, the pipe throws off an extremely high temperature.

The most promising improvements being made to cut costs and increase efficiency, are along the lines of atomizing fuel by high pressure instead of heat. This method involves no smoke and no waste, and may be operated with gasoline, kerosene, or Diesel oil. Various types of burners developed to use cheaper fuels by the National Development and Research Committee, British Petroleum Warfare Department and others, are also being tested.

At Arcata, automatic control of installations has been arranged so that an operator in the control tower can, by pressing a couple of buttons, ignite more than 2,000 feet of burners, thus lining the runways with banks of flame. At the same time, experts on the field gather data on the experiments. The type of fog, size of fog particles, dew point, temperature, temperature of the ocean water, wind velocity, barometric pressure—all are recorded. An amplifier on the control tower permits men in the tower to talk with those on the field. Walkie-talkie units are also used for this purpose.

Among the nonthermal systems being tested, the sonic method has created considerable interest. It is based on the principle of changing fog to rain by high-

frequency sound wave bombardment. Sound waves bounce the particles around, causing them to meet and merge, thus forming units large enough for precipitation as raindrops. The equipment consists of a series of powerful, air raid type sirens with 24-foot wooden horns to direct the sound. Sound wave fog dispersal, if it can be effected with more easily portable equipment, has practical potentialities for aiding carrier-based aircraft. Present investigations may lead to developments which will allow carriers operating in fog-bound waters to improve their own weather conditions.

The wind current method offers still another promising phase. With a cross-wind blowing on the runway, a huge blower throws a curtain of hot air at right angles to the wind. This causes the wind to move in a vertical circle, thus dispersing the fog.

When we consider the advances which have been made in automatic controls for piloting aircraft, it might be supposed that full instrument landings would obviate the need for a fog dispersal system. Low-approach equipment and navigation aids will bring a blind aircraft safely down within 50 to 100 feet of the runway, but from then on the pilot wants to know and see what he is doing. Even if full automatic instrument landings do become a pra reality, the actual and psychological benefits come of the pilot being able to see that everyth cleared for the ground contact, will still ma certain amount of fog clearance highly desirabl

Since the use of radio glide and localizer bea direct the automatic pilot will line the aircra with the runway, fog clearance need not be as e sive as those provided by the test burns. A ceili 200 to 300 feet should be adequate. The la aids at Arcata include "sliding" beam apparatus to supplement the work of the weather fixers, r a substitute for it.

A typical FIDO test flight report indicates tl sults being obtained at the experiment station. field had zero ceiling and visibility when the bu were ignited. Five minutes after ignition, ceilin 1,000 feet near the center of the runway with visibility the full length of the installation. The p a PBY 4–1, took off from a cleared runway, b soon as it passed the last burner it entered a zer bank of heavy fog. The fog was topped at 2,70 over the ocean and gradually rose to 3,500 feet land . . . and FIDO burned a hole comp through it. Landing was accomplished with u

Home fires burning through fog aid in saving lives and aircraft.

Operator at central controls electrically ignites more than 2,000 feet of burners at Arcata.

dio range station and SCS–51 approach gear, ınway becoming clearly visible at ½ mile and :et. However, the ground could be seen from :et and about a mile from the runway. The ;al was caused entirely by the FIDO operation, rrounding area still being zero-zero visibility and ;.

: pilots who made this test run expressed com- satisfaction with the FIDO operation. They ed they noted no undue turbulence or floating, ıat the use of flame in the operation presented no l hazard once the pilot had seen it in use. On of the test burns, the cleared hole was large h to permit aircraft to circle the field and land y by contact. When modern approach gear l, just a few minutes of heat will provide enough ; to care for almost any situation.

n's control over nature in these experiments is, rse, only a temporary victory . . . achieved for eded period of time then lost again. Lest man e too enamored of success, the elements imme- , revert to their former status, as witness this on reported in a test burn:

)945 one morning, visibility was $\frac{1}{16}$ mile, ceil- feet, temperature 53° F., humidity 100 percent. urners were ignited and at 1015 the sky became visible through a thin strata, with a variable ceiling of 800 feet. Visibility was good over the entire length of the installation. An hour after the burn started, the maximum surface temperature of 66° F. was reached, and humidity had dropped to 66 percent. Large portions of sky showed through the 1,700-foot depth of fog. Then the burners were turned off. About 15 minutes later the ceiling had lowered to 100 feet, visibility was down to ⅛ of a mile instead of the full length of the installation, and humidity had gone up to 94 percent.

When the Navy made public its program at Arcata, the importance of the project to an air-conscious world was reflected in the interest evidenced by the newspaper and magazine press throughout the country. The commercial air carriers, recognizing that the closing of one or two key fields will quickly disrupt the schedules of an entire system, are watching the experiments closely. Just as the progress up to now has resulted from the combined efforts of the Army, Navy, British, and civilian research activities, so will the benefits deriving from the work of Landing Aids Experiment Station accrue to all whose business it is to achieve the maximum of safety for aviation—military and civil.

the rubber boat, friend and fighter

Because we started out to obtain it at a pretty late date, the only biography of Lieut. Colonel Maynard M. Nohrden available at press time was . . . that he is a colonel in the United States Marine Corps. Yet, thinking it over, what more of a biography does a man need.—Ed.

THE rubber boat has likely destroyed as many enemies as it has saved friends. Such a doubled weapon can scarcely be found in any other category of the armed forces, unless it is in the amphibian tractors LVTs or the Dumbos PBYs.

The commanding general of the First Marine Brigade predicted in 1940, at the final critique of Fleet Landing Exercise No. 6 at Culebra, P. R.; "The rubber boat is here to stay. It is a new and effective weapon." This craft had just surprised many amphibiously trained officers and men with its deft ability to go places and do things under conditions prohibit ordinary boats. It had appeared from behind l ers coming into the beaches and disappeared j easily in the brush to the complete consternation opponents. Six inches of water or 6-foot br over a coral reef were taken in stride by this little Quickly inflated for use, easily deflated for co ment or stowage, it put a new complexion on th of small boat usage.

Like the amphibian tractor this craft was conc of Mercy rather than Mars, having been designe

er for use under special conditions. One of the bs accomplished by this collapsible pneumatic as as a standard piece of equipment in many larger naval seaplanes in the thirties. This ellow bundle of insurance became a very cons passenger aboard many of the large flying s it faithfully stood guard over the lives of the crew and passengers, and indeed it is to ry odd blob of fabric that many a flier today his very existence and continued ability to fly. as, the air services have spared nothing in their s and efforts toward an extensive air sea rescue m, it is upon this simple rubber keystone that of the life saving work directly depends. The this boat as a life raft aboard surface transports emely expedient in that it can be carried in a condition for simultaneous launching and in- by the pull of a single release toggle. It is foolproof due to its flexibility, while its ncy is far in excess of requirements.

rubber "raft" was originally a very unpredict- ulnerable and temperamental item upon which of the early skeptics looked with much doubt. early form, the development of the rubberized for the hull left much to be desired in respect ability, strength, and ruggedness.

reliability of the automatic CO_2 inflation system bject to the vagaries of weather, trial and error at ever unknown factor, the human equation. oat was treated as are most neophytes. The lack pect for this little craft is indicated by such ations as the "doughnut" as applied to the one- ariety and the "beautyrest" reference to the three-to-seven-man sizes. Having won several ant innings in the game of rescue, however, withdrew some of their earlier skepticism and ers decided that with some grooming, develop- and training, the rubber boat had definite pos- es for a post in the important positions.

gn engineers, research men and aviators were the job of development, experimenting, and . Their inventiveness, ingenuity, and practical ran the gamut of imagination in fitting out ittle craft. The correct combination of rubber bric for the hull had to be arrived at; flexibility, ss, and durability were required for ease in g, stowing, and breaking out; foolproof infla- ystems were aimed at, while the controlling sions and the incidental equipment occupied the of the engineers who had to compromise be- the necessary and the desired. The craft had capable of long periods of storage, it had to resist deterioration due to the variations in climate; it had to possess the qualities of a "minute man." Such refinements as a sun awning, solar evaporator, and a "complete" fishing kit were added, while improvements in auxiliary hand air pumps, patching gear, sea anchors and bailing buckets were cleverly devised, all in a waterproof rubber envelopes attached to the boat equipped with a corrosion resistant zipper opening.

Introduction of a seven-man rubber life raft to Marine Corps aircraft brought the attention of personnel in this arm to the possibilities of employing its flexibility in the various phases of landing operations. Experiments in tactical use of this craft were made at several Marine bases. As alterations were made to strengthen fabric and basic construction, general rather than emergency use of the craft took shape and promised permanency of character. Amphibious experiments were conducted for the new LCR (Landing Craft Rubber) as early as 1939 with the U. S. S. *Manley*, an APD (ex-four stack destroyer) in the Quantico and Virginia Beach areas, thus working both personnel and craft under actual water and beach conditions. This afforded the first practical opportunity to iron out personnel and material wrinkles.

Development of the rubber boat from a tactical angle was now in order. From an embryo rubber float, balloon-like and extremely difficult to maneuver, the craft was stiffened by a higher gas pressure inside a stronger casing to emerge as a landing weapon, compact and handy. Sharp aluminum paddles were replaced by a detachable wooden type; the automatic CO_2 inflation system was perfected; a triple strong bottom was installed for protection against coral and sand chafing. With these changes the 7-man emergency rubber life boat began to take shape as a 7-man rubber landing boat vested with strange, but potent peculiarities and potentialities.

Deflated and rolled in its case, this craft appeared as a slightly over-sized sea bag, the CO_2 flask weighing about 4.5 pounds being integrally included. To be put into operation, it was necessary only to un-zip the carrying case and open the CO_2 valve. In 10 seconds the boat was inflated and ready for water use. Convenient lifting handles for carrying were provided; grommet type row-locks, conveniently placed valves for hand-pumping additional air, and of course, the first comfortable thwarts ever designed were installed. The outstanding tactical addition was the clever design of a curved machine gun base plate which would fit on either bow. This was of a stainless steel or duralumin fitted with securing

straps which tied in with eyes strongly reenforced to the hull fabric. A .30- or .50-caliber machine gun of standard design could be readily mounted and fired from this adapter. It is interesting to note, however, that the recoil reaction of the gun firing propelled the boat astern about 2 knots which was just about the average forward speed attainable by paddling. By the same design, there was adapted an outboard motor mount complete with a small transom, measured to take the motor brackets. The problems resulting herein were many. Lack of rigidity of the boat permitted the screw thrust to buckle or bend the entire boat amidships; the tendency of the screw to "run under" the stern bent the entire stern tubing so that the after wash nearly swamped the craft. These and many lesser problems were solved with only the tedious study, trial and error methods that design and testing personnel never advertise. This produced the first LCR possessed of most of the characteristics of a regular surf landing boat, and many more of a valuable tactical nature.

The final step in development produced our present 10-man rubber landing boats, possessing the advantages of the smaller craft, plus greater capacity. The new boat was provided with a special pneumatic flooring, not unlike a rubber mattress, which added stiffening and buoyancy. This prevented buckling when under tow or own power, added buoyancy, increased the capacity and safety factor. The motor was protected from a following sea by a rubber-fabric canopy fitted to a tubular frame over the motor. A high bow and an antispray fender around the entire craft was added to keep personnel as dry as possible. This boat has been towed fully loaded at 25 knots.

The "hull" was developed by a major rubber company into a very strong rubber-impregnated fabric which possesses the combined qualities of flexibility and strength, covered with pigmented cement and coated by a long-baking process, the surface is impervious to water, wears well, and resists the combined deteriorating effect of sun and salt for a long period of time. The boat was sectioned into 11 separate compartments, the main elliptical tubing divided into 2 horizontal compartments, while each of the 3 thwarts represents a separate entity. The flooring is divided into 4 parts and the 2 antispray tubes complete the divisions. Each compartment is equipped with a noncorrosive valve for hand-inflation. The large 10-man boat is 15 feet 7 inches long and 7 feet 3 inches wide, while the main tubing is 18 inches in diameter. The maximum height from the bottom is about 30 inches, due to the upturn of the bow.

Embarking, towing, and paddling represer three phases of training in use of these boats fo phibious operations. Each man is employed phases of the use of the craft, for he is a paddle a fighter. The boat can be consistently padd about 2 knots. Wind has a great effect on the pr of the craft. Use of the outboard motor, or t can effectively be executed at 4 to 8 knots depe on the size of the motor or tow and the conditi wind and sea. Boat discipline is of great impo in these specialized craft. Each man must know to do, when to do it, and how, without directi the time of actual landing. Practice in embarl and debarkation from a transport is necessary t fect the personnel in this important phase of la During initial training the men are usually d into three groups, each rotating through these phases.

For embarking, boat personnel are issued all sary gear well in advance of embarkation, wl from a ship, submarine, or plane. They are di so as to be as near the rubber boat launching pc the transport craft as possible. Rifles are bund as to present an easy load for lowering and secu the boat. Paddles are temporarily bundled for ing into the boat. All hands wear life jacket the packs. If a machine-gun is taken, it is b down into a three-man carry and handled by its

The rubber boats are thrown overboard and l alongside by the bow and stern lines, whereupc barkation takes place at a rapid rate. After loaded, the rubber boats proceed to their desig power boat to rig for towing. When the boat g are formed, the power boats with tows of 2 to ber boats, proceed to the rendezvous area, and signal from the guide boat to proceed in format the line of departure. Tows approach within 1,000 yards of the beach where by means of autc release hooks, the rubber boats are freed from th boat and then proceed to the beach under thei power—either by paddles or by quiet outboard n

One portable radio receiver-transmitter is u carried in the guide division boat for communi with the ship to report emergencies or inforn and also to receive any necessary coaching. stern of the towing boats is carried a blinker tul blue stern light for position purposes.

Tactical surprise is the forte of this craft since it can land practically anywhere it will e landing on the beach least likely to be defende flexibility for use from aircraft has already bee

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strated. From submarines, ship, or shore, it reconnaissance, or landing in force possible : natural barriers almost insurmountable for the e boat. As a reconnaissance weapon, it is unsurpassed in surface vehicles and in short, ecoming a jack of all landing trades

this Janus-like friend while smiling with a y smile on the one side was found to wear a ferent expression on the other. It was a mar- pression which indicated an ability to wield the

Quick to plumb the offensive possibilities of aft was the United States Marine Corps. A development program was launched to adapt use on intelligence missions, raids, and even ll-sized assault units, which later became the Raider Battalions. Presto-like, this lifesaver ecome a life taker, cunning and ingenious— e of negotiating rough water, shallow-water, nd surf. It was difficult to detect due to its houette and hence difficult to hit with small- ire. It was capable of landing on any section ach, and equally capable in withdrawing there- They were usually launched from submarines it, or from small assault surface craft, just off le shore. If an intelligence mission was as- the boat was usually paddled silently into the beach, deflated, and hidden while the scouting thering of information was in progress during ylight. When darkness covered the movement, erse process was effected. On an assault mis- iere surprise was a key element, these craft were propelled by their motors to a point just out- e reef or breakers from where the paddles were or the final spurt. Machine guns and radios, aterproofed, were in constant readiness for use afloat or ashore, being rigged with special bious adapters for such bilateral use. The raft had become a fighting craft.

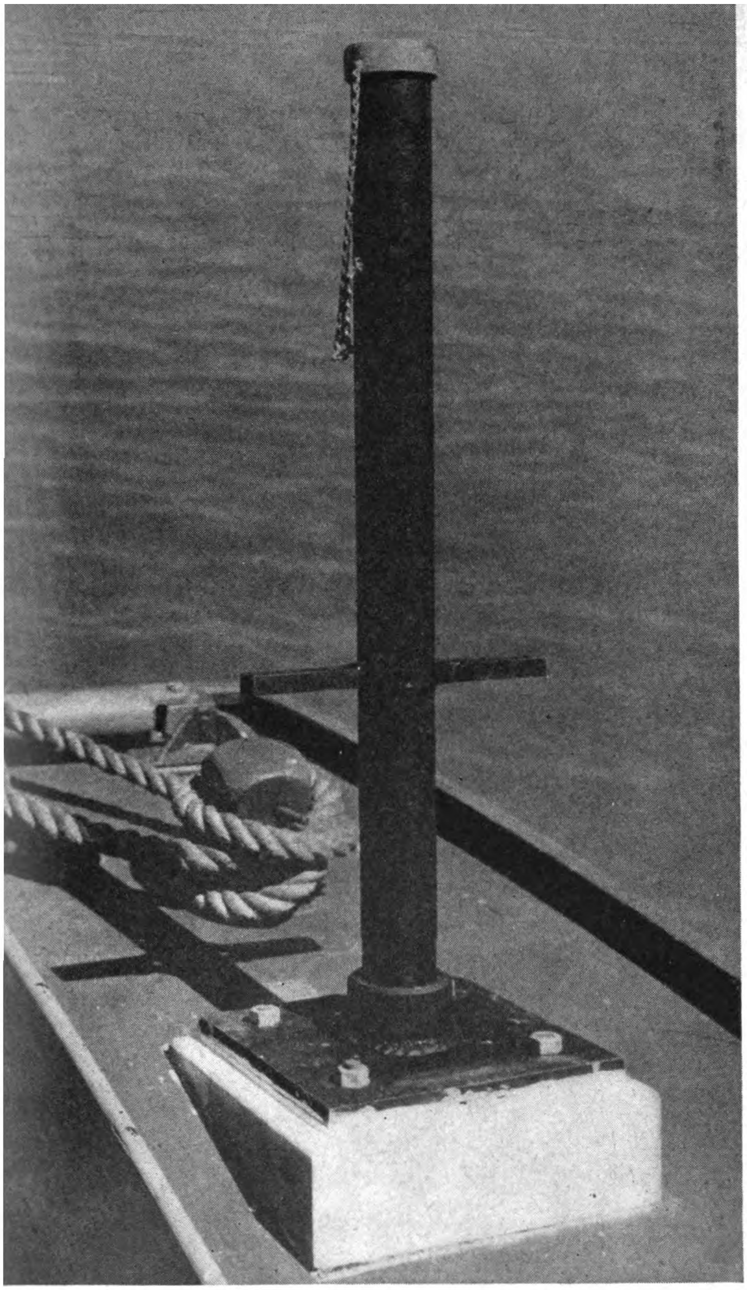
943, the Army Air Forces conducted a series of ure" tests in these rubber rafts with volunteer as observation boats stood by to take data, gs and photographs of the experiments and also ler immediate aid or rescue to any of the men ight appear to have gone beyond a safe limit urance. Simultation of South Pacific condi- ere effected and the data obtained were later great advantage in subsequent improvements rafts which today accompany our airmen to orner of the globe. The great tests, however, iose of emergency, with life and death; herein s for the rubber boat were written in the blood , as are most other safety rules.

The use of the rubber boat in its various forms in air sea rescue are beyond account. The extreme strength built into this craft as a fighter was equally adaptable to use as a savior. There is no more spectacular and successful lifesaving maneuver than the air-drop of a rubber boat from a rescue plane at sea. The highly developed system permitted of unbelievable extremes in perfection so that the precentage of lost personnel reached the vanishing point, as compared with lost planes that had been downed.

Basically the system involved the prearranged preparation of air sea rescue planes, usually PBYs, coded as Dumbo planes. These carried the rubber boats completely equipped as heretofore described with such additional items as a two-way radio, smoke pots, and numerous streaming life lines, emanating from the small boat. On emergency call or even anticipating them, in following up a long overseas hop by large numbers of tactical planes, these Dumbos would answer radio calls immediately as directed, spot downed aircraft and personnel, and make their rescue in any of several ways. In the event of permissible sea conditions, the Dumbo could land and pick up survivors, otherwise the old faithful rubber boat was dropped upwind, automatically inflated, and positioned so as to drift down on its intended passengers. The smoke pot which has been actuated in connection with the boat enabled easy location by the survivors, the streaming life lines helped them to catch control of the boat and pull themselves to it. The record of aviation personnel brought back to fly again by this ingenious device is almost unbelievable.

One other unadvertised, but indirect life saving mission of the little rubber craft, was its employment by the great Underwater Demolition Teams of the naval service. These groups used these boats in stealth, silence, and darkness, to destroy submarine defenses of the enemy on many a shore marked for invasion by the United Nations. This insurance policy undoubtedly saved inestimable lives on every advance made against a beach.

"Love Charlie Roger" was now a fighting boat in its own right and was adopted by all the arms of the services of the United Nations. Ground forces used it for river crossings, air forces for life saving, service forces for emergency supply work and pontoon bridges, while the amphibious forces used it for assault on otherwise unapproachable islands and shores. It was a craft adaptable to many uses, in many fields, and climes, and is today, having finished its work against aggressors, continuing its efforts against the elements in the cause of safety.



Showing the complete projector assembly on boat deck. Reinforcement below deck was necessary for added strength against recoil.

high altitude parachute flares

A HIGH-ALTITUDE parachute flare and flare mortar—designed to illuminate seaplane landing areas at night, to permit aircraft to land on the water at night within a marked channel, or to locate an island base when low ceilings do not provide proper visibility from normal flying levels—has been authorized for installation on all Coast Guard 63-foot rescue vessels. The Coast Guard's naval engineering section is also planning to install them on all 110-footers.

In the past, night search missions have been a
by parachute flares dropped from aircraft. How
such night searches were handicapped by the ina
of aircraft to carry a sufficient number of flare
extended search, and were obliged to return to l
bases for additional flares, or to request relief by
aircraft. It is expected this high altitude flare
eliminate those disadvantages.

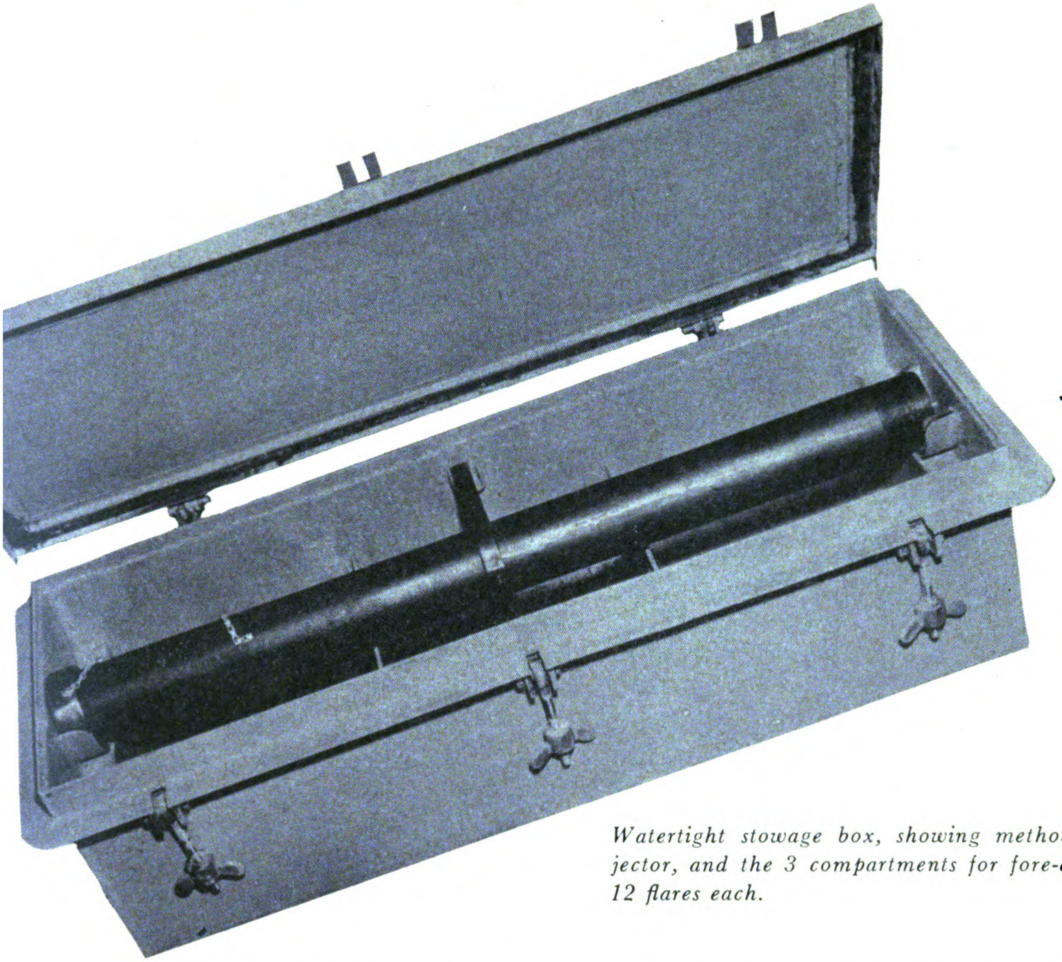
The complete flare weighs about 5 pounds and
the form of a cylindrical steel tube with a coppe
welded to the closed end of the tube. The ov
length of the signal is 10¾ inches and the diar
is 2½ inches. The flare body, with the coppe
welded to it, contains a parachute, the pyrote
candle, and the expelling charge. The copper
contains a standard shotgun primer, the prop
charge and the fuse assembly. The propelling c
consists of 25 grams of a combination of smokeles
black powder.

The mortar is a steel tube which screws into a
plate. The mortar tube is 36 inches long an
inches in outside diameter. The steel base pl
¾ inch thick and 12 inches square. Four hol
drilled in the base plate for attachment to a co
base, or to the deck of a boat. The base plate i
vided with a central stud into which a hardened
firing pin is pressed. Should it become necess
replace the firing pin at any time, the stud m
easily removed with a socket wrench provided
each mortar. The base plate is also drilled with
vent holes for the dual purpose of providing me
vent air from the tube to permit the flare to fall
against the firing pin, and to provide a drain fo
water that might enter the tube.

The upper end of the projector is drilled transv
to receive a release pin with a 30-foot lanyar
tached, for the purpose of supporting the flare
to firing. Each projector is provided with a
closing cap to exclude dirt and moisture.

The signal, after being dropped down the m
tube, will be propelled to a height of approxin
1,000 feet. At the apex of the trajectory, the
technic is expelled and burns with a white lig
85,000 candlepower. The burning time is abo
seconds, during which time the flare and para
descend at the rate of about 6 feet per second.

The mortar may be mounted on the beach adj
to the landing area, or on a boat deck. The
plate should be mounted on a rigid base, prefe
concrete. In any event, whatever material is u
a base, it should have a channel approximat



Watertight stowage box, showing method of stowing projector, and the 3 compartments for fore-and-aft stowage of 12 flares each.

vide running directly under the vent holes in : plate in order to vent the trapped air.

nortar should be mounted at an angle of 15° e vertical, in order to minimize the possibility lare case falling back on personnel after the and parachute have been ejected. If pose mortar should be mounted so the expended l fall back into the sea. Consideration should given to the direction of prevailing winds, in) avoid having the flare drift over buildings mmable material. Although the flare will en completely burned out at about 400 feet, it le that it may descend considerably below this

ι mounted on shore, a wooden barricade be erected about 30 feet from the mortar which the lanyard will be pulled. This will protection against what slight possibility nay be of premature functioning. When d on a boat, steps should also be taken to adequate protection for personnel.

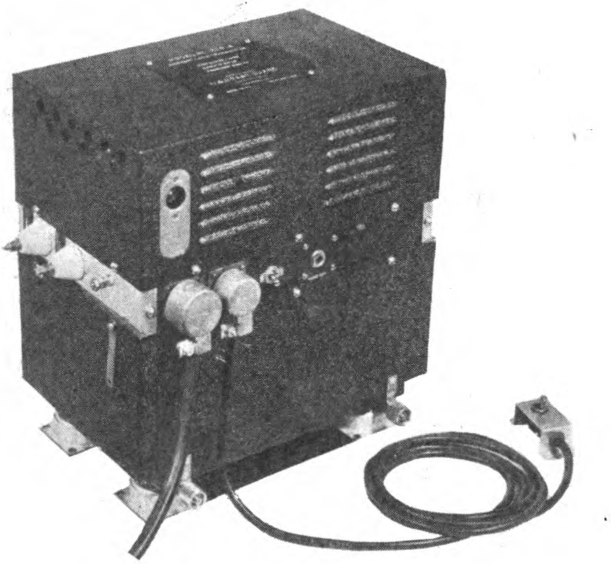
completion of exhaustive tests conducted by ıst Guard Air Rescue Unit, Northern Cali-:ctor, discussion of the flare's efficiency brought on a clear night, the flare will illuminate an area of about two square miles; if the overcast is 2,000 feet or higher (clear night), the area of illumination will be the same; if the overcast is below 2,000 feet (clear night), the flare will illuminate about one square mile; if the overcast is below 500 feet, the burning time of the flare, after it falls below the overcast, is too short for it to be of practical use.

The distance at which persons and life rafts may be seen from a rescue boat by the flare's illumination will vary—depending upon visibility, height of the object above the water, its color, and the position of the flare in relation to the position of the observer and the object of search. It was found that the best results were obtained when the object was silhouetted by placing the flare behind it.

It was further found that in order to insure good coverage of an area, it should be swept at least twice, and as many lookouts as possible should be posted—all of them thoroughly briefed on the size, shape, and color of the objective.

Aircraft, of course, can sweep a larger area in less time with one flare, and the boats can also search by the light of the flare dropped by the aircraft. It was recommended that aircraft remain above 1,500 feet when using these high altitude parachute flares.

the safety transmitter and world-wide HF/DF airways



JET plane flights from New York to Washington in less than 30 minutes—radar contact with the moon . . . these are but two of many developments which symbolize the advance in two fields of science—aviation and electronics.

News stories of rapidly recurring accomplishments in these fields are understandably bewildering to the man in the street. He is vaguely aware of tremendous forces at work which will alter his way of life—speed its tempo—make him neighbor to the world. Yet, unless he has a direct interest in one of these fields, it is not particularly important to him which one of them advances more quickly than the other. Aviation, because of its closer, more practical human aspects, may lend itself to more dramatic news presentation . . . while electronics, a more technical subject from the point of view of average knowledge, may lack the "color" necessary for quick public assimilation.

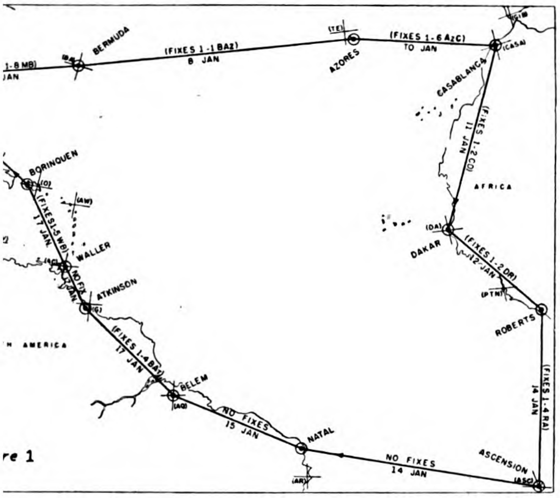
What is important to him, however, is that these scientific developments be permitted to continue in order to provide the greatest benefit to the greatest number; and that we shall not fail to capitalize on the tremendous advancements in scientific research and development which were "pressured" by the urgent requirements of war.

Scientific development in the electronics field has permitted undreamed-of progress toward the mastery of space—it has, for all practical purposes, reduced the world's areas to a series of inter-dependent n borhoods. Most of the finest achievements in electronics field know only the application of wa needs. Their potentials of usefulness to a peace world have not yet been fully tested, although doubt exists that most of them will here find greater fields for service.

During the war, the radio and radar dire finder nets represented an important cog in the of military intelligence. They were used to ' enemy radio and radar stations, and extract plans and secrets. They sought out the en watched his movements, tracked him down. ' were the eyes and ears of our aerial missions—gu them, watching over them, directing them safely to base. Their value in wartime intelligence safety work is a matter of record. It does nc quire any unusual imagination to visualize the of such a world-wide locating and safety servi the world of today and tomorrow. There wi obstacles, of course, but a firm foundation has laid upon which continued research may be exp to effect a practical conversion.

A comprehensive network of world airwa already in being and is subject to rapid, contin expansion. Intercontinental flights over long panses of water and sparsely populated land ar a daily occurrence. One of the basic structures which the successful operation of this world-wid ways system is built, is the organization whose jol to make these world-wide routes safe and, when dents or emergencies do occur, to provide an effi search and rescue service. Such an organizati already in existence, with a "know-how" of o tion based upon a wartime experience which has effectively transposed to a useful peacetime func This one phase, in itself, offers a fertile fiel opportunity to the electronics engineer.

A fundamental requirement of this search and cue organization is for a system of communication will make it possible to alert its various compo quickly, and locate an aircraft or vessel in di accurately. Wartime experiences indicated that direction finders offered a possible solution. mendous strides had been made in the realm of



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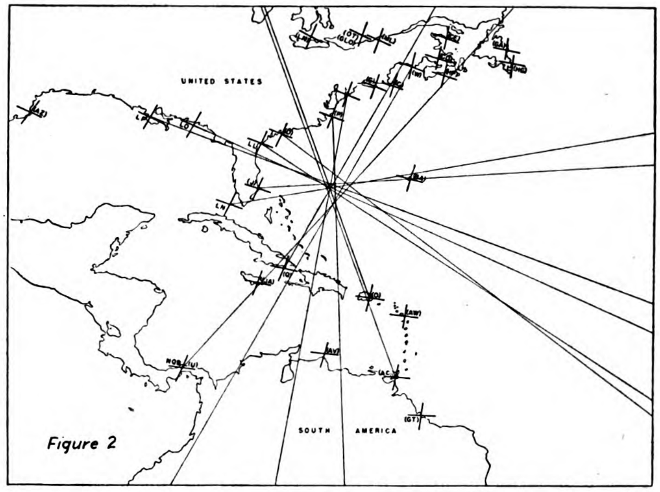


Figure 2

cy direction finding, and certainly it was ɔle to assume that its benefits could be effi- ıpplied to servicing both a world-wide airways and the "safety," or rescue, organization which ɜd it.

ɔnics engineers of the United States Coast conducted considerable research and experi- ı many phases of the problem. Particular s was placed upon the development of an air- utomatic transmitter which would transmit signals on the 8280 kc. band, and close the gap ɔy the peacetime reduction in the number of ar listening posts. The transmitter, known as -226–A, was described in the February 1946 ɔf the Air Sea Rescue Bulletin.

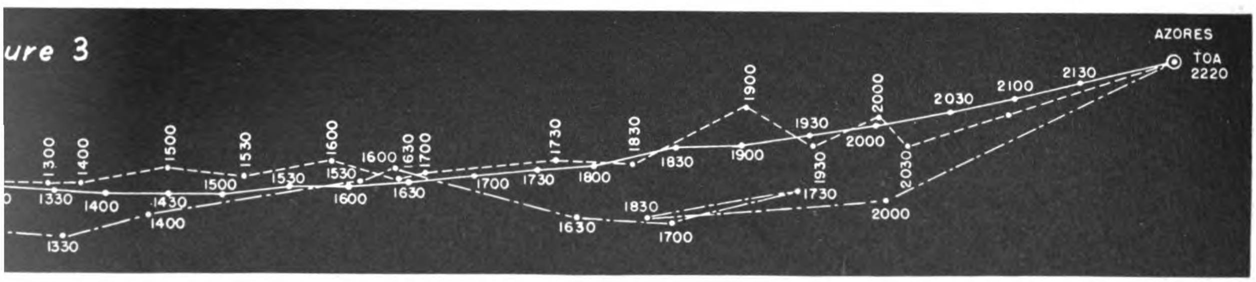
ɔroject was first initiated early in 1945. Ex- tal models were built, tested, refined, and re- . until finally the unit was believed ready for ve field trials. In December 1945, following conference of representatives of the Caribbean AAF, Air Transport Command and various uard officers, arrangements were completed to these trials. The RL–226–A, with the ng designator "CD," set up on a frequency of , was installed in an Army C–54 aircraft, No. The plane took off from Morrison Field, West ɜach, Fla., on 7 January and returned on 18 January 1946. Tests were conducted under the supervision of Capt. F. Catanzarite, flight radio officer, Caribbean Wing, ATC.

So far as is known, this operation, which proceeded from Morrison Field, Fla., to Bermuda, the Azores, Casablanca, Dakar, Roberts Field, Ascension Island, Natal, Belem, Atkinson Field, Waller Field, Borinquen Field, Miami, and back to Morrison Field, was probably the first thoroughly coordinated HF/DF test effort to actually "track" an aircraft on a transoceanic flight . . . and it is safe to assume that additional such tests will improve the accuracy of bearings and the consequent evaluation of fixes.

Figure 1 charts the entire route of the flight, and shows the dates and the indicator for the charts of the individual plots for each fix.

Figure 2 showing the large number of stations which were able to take bearings on the leg of the flight from Morrison Field to Bermuda, illustrates what is known as a good fix. Eight fixes were taken on this leg of the flight, all of them combining to provide a high degree of accuracy.

Figure 3 shows the track of the flight from Bermuda to the Azores. During the early part of this leg— up to 1730R, and until bearings were received from stations in Great Britain relayed from the Eastern Sea Frontier Evaluation Center, fixes continually "lagged" the DR positions. Incidentally, this was the



ure 3

first opportunity afforded the Gulf Sea Frontier Evaluation Center at Miami to observe bearings from this area, and the experience was valuable. The number of stations which were able to take bearings on the Bermuda-to-Azores track are shown in Figure 4. After bearings on the Azores run were obtained from stations in the British Isles, it was possible to plot more accurate fixes. The AACS fixes alone, point out the desirability of a larger number of bearings to provide for more successful fixes between Bermuda, the Azores, and Casablanca. This will require the close coordination of all agencies . . . the combined effort of the Coast Guard, AACS, and United Kingdom nets.

On the leg from Borinquen to Miami (Fig. 5), there were nine transmissions and nine fixes plotted which provided excellent overall results. All of the D/F Net Stations participated in bearings of each of these transmissions. The letters DR on this chart indicate the position of the plane as determined by its navigator; ZE indicates the plane's position as fixed, or plotted, by the D/F Evaluation Center.

Figure 6 shows the fix and illustrates the station plots on the flight leg from Roberts Field to Ascension Island.

Summarizing . . . 8 fixes were obtained on the leg

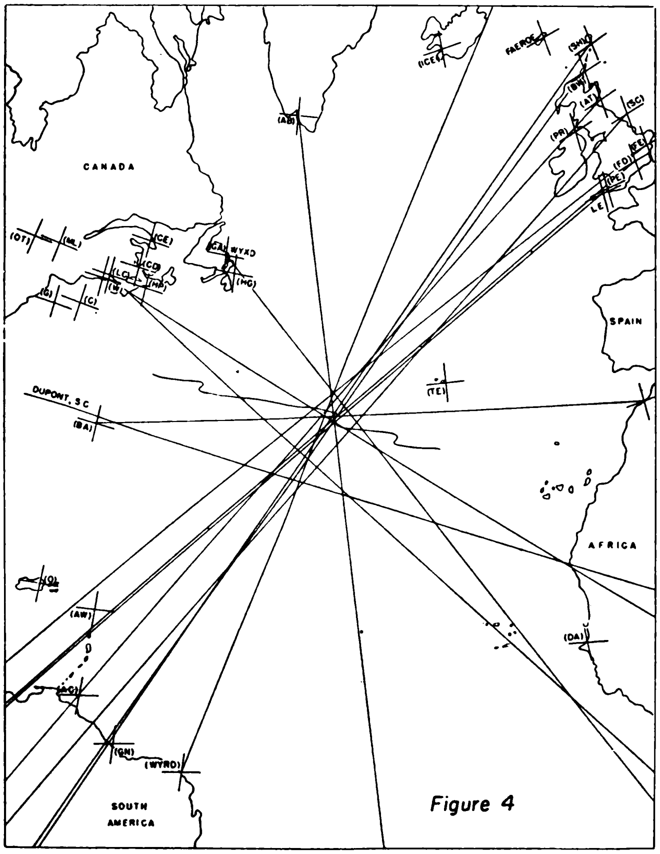


Figure 4

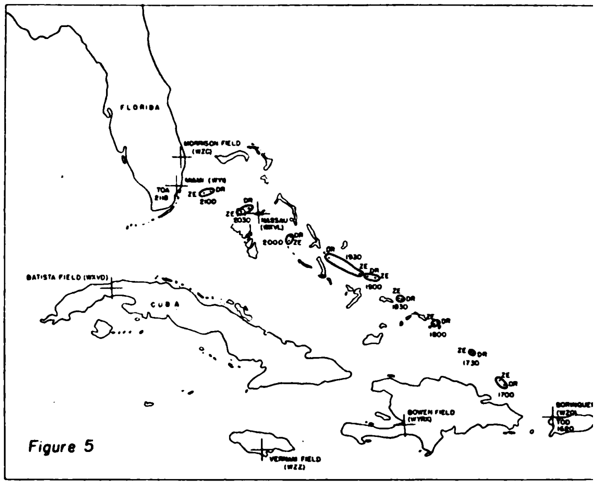


Figure 5

from Morrison Field to Bermuda; 15 from Ber
to the Azores; 6 from the Azores to Casablan
from Casablanca to Dakar; 2 from Dakar to Rol
4 from Roberts to Ascension; none from Ascensi
Belem; 4 from Belem to Atkinson; 5 from Atk
to Borinquen; 9 from Borinquen to Miami.

The report of this test and an evaluation of i
sults, definitely does not represent the ultima
achievement. It is merely a beginning . . . and t
in lies the greatest hope for the future–
from this beginning will eventually come an impo
contribution to safety at sea and in the air, thro
system of communication so sound and so compl
its conception as to remove the last final eleme
guesswork or mechanical failure.

Here is a transmitter with a low power output
10 watts, which demonstrated its ability to oper
distances up to 5,000 miles. Unquestionably its r
of performance indicates that further tests shou
made in order to realize the fullest potentials
transmitter of this type, coordinated with the HI
network.

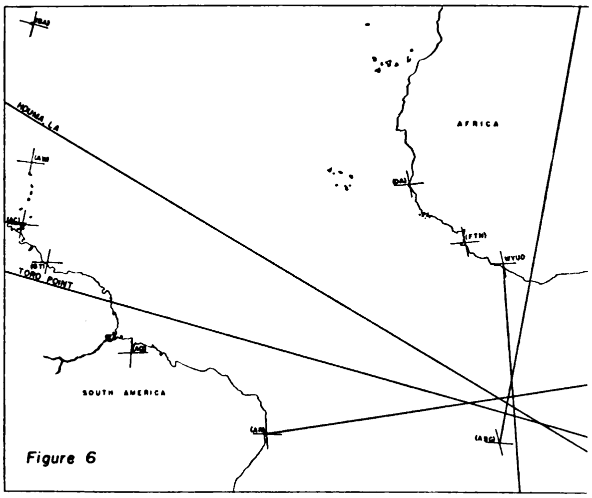
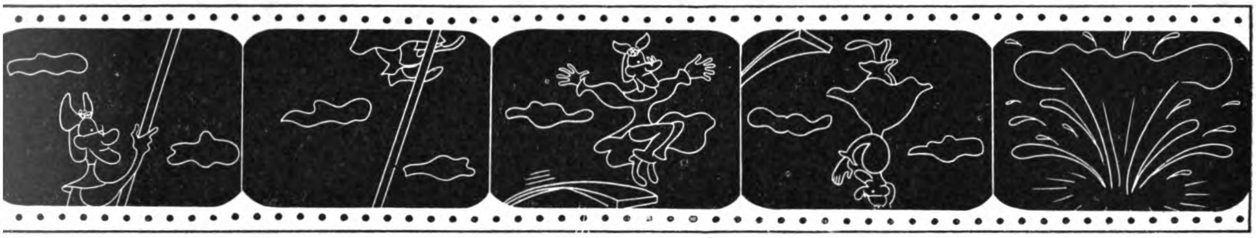


Figure 6



nematic

ıtholicon

Prior to his assignment to the Air Sea Rescue Agency as Motion Picture Officer, Lt. Comdr. Don Farran was, for 3½ years, a writer-producer of motion pictures for the Navy, averaging one picture a month in color. He was formerly national director for many of the largest research projects conducted by the United States Library of Congress; is the author of many short stories and articles for national magazines; is the author of a life of Johann Gutenberg, inventor of printing; editor of many bibliographical volumes; playwright and script writer for radio and motion pictures.—Ed.

THE Provisional International Civil Aviation Organization's Dublin conference during 1946, the following recommendation was ›usly passed:

:eas each member State is dealing with the of search and rescue personnel is desirous of g instructive material; and

:eas only a very limited amount of search and ıstructive material is now available; and

:eas motion-picture films represent an excellium for training instruction; and

:eas the Air-Sea Rescue Agency, Washington, able in its library, information for such search ue training information;

:herefore it is recommended that the Air-Sea Agency be requested to prepare two or more circulation among all member states within th Atlantic Route Service Organization for ›ose of instructions to search and rescue air ›und crews with the expectation of gen›rovement of search and rescue operations ›ut the area.

ıing that the purpose of such films will be to standardized practices and techniques from ember States may model their own search and rganizations, a broad program of motion picd training films seems indicated. Questions ng the financing of such a program belong to ıer than this one, whether they be the armed PICAO itself, or member states. What we ıere is the utilization of films already produced planned, for the expressed objectives of ex; the best available practices between member a form which can be understood and which will not be subject to misinterpretation. The use of appropriate language soundtracks is contemplated.

The suggestions and comments contained in this article are not official, but are offered as an attempt to approach some of the problems involved in setting up a search and rescue system between member States.

OPEN SEA SEAPLANE OPERATIONS NO. 1

This is a 30-minute motion picture in 16 millimeters black-and-white, sound, cut from footage shot during rough water landings and take-offs with a PBM–3 plane off the coast at San Diego during 1943 and 1944. The tests were made to determine the best techniques in rough water operations; i. e., landings and take-offs, with seaplanes equipped to measure various stresses on the plane, etc. Essentially a photographic report film, it should prove invaluable to military and civil personnel operating planes of similar types. Additionally, it may be of value to pilots who are faced with the necessity for ditching and who are unfamiliar with the danger of swells in the open sea. Produced by the United States Coast Guard Air Station, San Diego, the picture is distributed by the United States Navy.

STANDARDIZATION OF OCEAN STATION VESSEL CREW PROCEDURE IN SEARCH AND RESCUE

This is the first of a new series of training pictures designed to standardize crew training in SAR aboard Ocean Station Vessels. It will consist of a number of pictures, each concerned with training in a particular subject, such as:

(*a*) OSV crew drills during search and rescue;

search Doctrines when OSV must leave station and search vicinity for survivors.

(*b*) Pick-up boat crew training, including rescue of injured (flotation litter, rescue basket, etc.) and treatment for shock, exposure, etc.

(*c*) Operation of communication devices (electronics).

(*d*) Operation of aids to visibility (manual signaling, searchlights, pyrotechnics, float lights, smoke markers, etc.).

(*e*) Training in operation plans between OSV and "ditching" planes.

(*f*) Possible use of oil slicks with OSV wake to provide landing surface for planes to land or ditch upon.

The audience for these training pictures would consist of all personnel concerned with search and rescue on water; civilian air-line crews; foreign countries engaged in search and rescue, with appropriate sound tracks; and interested government agencies of the various countries.

Because of the importance of color in search and rescue equipment, it is hoped that these pictures may be shot in 16-millimeter color with sound, both for added visibility factors and approximation of real conditions.

STANDARDIZATION OF CREW TRAINING IN SEARCH AND RESCUE FOR AIR SEA RESCUE CRAFT (63, 83, OR 85 FEET (ARMY)), 110 FEET

This series of training films, like the ones mentioned above, will be designed to provide standardized crew training for smaller crash and patrol craft. Each will relate to specific duties, such as:

(*a*) Advanced training in basic seamanship, and training in teamwork with other boats of this type.

(*b*) Operation of electronic devices (when carried); of manual signaling devices, aids to visibility, etc.

(*c*) Proper use of exposure suits, life vests, inflatable boats, and rafts, rescue hoists, rescue baskets.

(*d*) Care and handling of survivers.

(*e*) Proper approach to planes forced down, and to rafts, survivors in water, etc.

(*f*) Training in operational plans between planes forced down or ditched and these types of rescue craft.

Because in general a particular type of small craft will be used by all military services in all countries, varying but little in power and design to fit local conditions of weather or sea or distance involved, these training films should well serve to train personnel concerned within a world-wide systen search and rescue. As in the pictures on OSV c mentioned above, these should be produced in millimeter color with appropriate sound track the language of use.

Only through standardized practices, as der strated in the films, may a foreign plane flying American waters or an American plane flying over eign waters obtain maximum safety in a search rescue situation.

OCEAN STATION VESSELS—DITCHING

In this picture a ditching situation is contempla involving a commercial air lines plane and passen While it is hoped that no such situation will exist, its possibility, if not probability, is such tha hands should be trained to operate without los time or energy. Survival for many lives of crew passengers may depend upon preplanning and ab to operate under any conditions, day or night, goo adverse weather, and good or bad ditching techni

The factors involved should consist of a comme air line plane, an Ocean Station Vessel, a patrol p with droppable lifeboats, and Rescue Coordina Centers and Rescue Units.

The problem is that of a commercial air line pas ger plane en route from abroad to the United St Near the "chop line" in the middle or Caribl area of the Atlantic the plane has failure on one or of its engines and notifies the nearest Coordina Center and Ocean Station Vessel that it may hav ditch. It proceeds toward the nearest OSV, whi just across the "chop line" on the American Meanwhile, a French patrol aircraft on long-r training flight in the area is ordered to intercept fly alongside the commercial air liner to provide protection of its droppable lifeboats, etc. The ordination Center, manned by the British, will i instructions to the two planes until the commercia liner ditches or until radio contact is lost.

As the air liner approaches the Ocean Station sel, it receives weather and surface condition rep and chooses the particular plan to be used (i. e. d ing to starboard, port, ahead, behind OSV, etc.) this way each knows exactly what the plan of other will be to effect an immediate rescue.

Commercial air liner ditches (done with m photography) in the assigned position, and the rescue boats effect the rescue of the survivors f the plane's rafts. Proper treatment by medical sonnel aboard the OSV is given, if required, anc

twork is notified that rescue has been effective. is, of course, a broad outline of the proposed All elements that comprise such a rescue included in the picture, such as communica- iterior of Coordination Center handling the , use of rescue equipment, creation of wake, nt of smoke markers, etc.

felt that this picture will establish procedure rify lack of information regarding such proce- ditchings near Ocean Station Vessels.. In to military use, it might well serve to in- ate commercial air line pilots and crews. ir liners may wish to use it as passenger tion.

ARDIZATION OF CREW TRAINING ARCH AND RESCUE PLANES

otion picture on this subject is as essential for training the crews of OSV's and smaller raft. In addition to teaching cooperation with Station Vessels and other rescue vessels at sea use of various communication, navigation, ety devices, it should instruct in the elements d Rescue, such as aerial supply to survivors, cation and marking of crash sites (photog- mapping, etc.), the use of the L–5 land plane, Norseman plane mounted on skiis, parachut- nedical personnel to survivors, etc.

oubt, this would break down into two series, ver water, and SAR over land, for appropriate es.

TION OF LAND RESCUE UNITS

elements of this picture or series would be ed in the SAR plane series mentioned above, ntially this is meant to cover the search and echniques covering land incidents, considered ound search instead of air search. It should organizational facilities such as communica- lephone, radio walkie-talkie, and their use), ding indoctrination, photographic interpreta- nsportation facilities covering all weather con- available personnel, including local civil tions (State or national guard units, local tc.).

series would tie-in with the following picture :

INATION OF LAND RESCUE WITH LOCAL AUTHORITIES

completely effective, search and rescue must very facility possible. Local or State units, such as militia, civil peace organizations, police departments, etc., should be coordinated with search and rescue and be prepared to act without delay on prepared plans of operation. In any SAR incident, human lives are at stake, and time and medical treatment are immensely important factors to survival. Like the local fire department, all hands must be prepared to act at once and act in unison under a central authority.

A motion picture which would present a rather ideal plan for such coordination could be the basis for creating it or serving as a model for it world-wide. Such a plan would be operative in situations other than flights by air, and would offer protection which at the present time is haphazard at best.

COORDINATION CENTER OPERATION

The center of all search and research is the Rescue Coordination Center. Operating 24 hours a day, every day, it is the "brain" into which flow the position reports of planes and ships in their ever-changing pattern. Connected by radio and telephone with rescue stations, offices of the militia and police, it can immediately alter all necessary facilities when SAR must go into action. It can divert ships at sea, send search planes, alert Ocean Station Vessels, or request civilian and military organizations to go into action.

A motion picture presenting its operation and functions during an alert and subsequent search and rescue would orient all concerned and serve as a model for similar Coordination Centers to be set up in all countries. Even since the war ended new devices have been perfected for insuring the safety of those who travel and are in use in some of the centers. Distribution of information regarding their operation, through the medium of the motion picture, would tend to bring them into use in all countries.

SOFAR

In this new medium of long-range, deep-channel sound transmission (see article in Air Sea Rescue Bulletin, April 1946) a well-known principle of sound wave constancy is utilized. Signals (bombs) set up at depths of from 3 to 4,000 feet below the surface of the ocean will register across vast distances, theoretically up to 10,000 miles. A plane ditching in midocean and dropping a signal bomb can be pinpointed by the recording stations.

A motion picture in animation describing the principles involved and the methods of determining a fix

would be of great value to all hands engaged in search and rescue, and particularly to search and rescue plane crews. Here is a prime example of how animated motion pictures can explain the application of new principles to search and rescue.

VISIBILITY RANGE OF SIGNAL EQUIPMENT IN SEARCH AND RESCUE AT SEA AND ON LAND

A motion picture on visibility of signal equipment, flares, mirrors, smoke signals, life rafts, parachutes of various colors, at sea is being cut from footage made during tests conducted off San Juan by the Bureau of Aeronautics. It is believed that a second picture should be made with latest equipment, to relate search doctrines to the position of the sun and with atmosphere conditions.

A similar picture should be made to prove visibility on land. Smoke signals and fabric coloration among heavily wooded areas, the variation of visibility on flat terrain and in mountainous regions, these and other similar aspects should be recorded by the motion picture camera so they may be studied by research men and plane crews engaged in search and rescue. Transmission of such specific information is best realized through motion pictures in color, with the possibility of third-dimensional camera use.

SURVIVAL, IN TROPICS, IN ARCTIC, ETC.

The Army has made a series of motion pictures, Land and Live series, which deal with survival in the Arctic, the desert, the Tropics, etc. A cutting job done on these pictures to provide a 30 minute composite film, if that is practical, would make very important information accessible to the plane crews in search and rescue of many countries. The series contains good photography and good acting, often by professional casts who were in Army service.

No doubt there is much recoverable material already shot which could be utilized in this way to provide much-needed information for all countries. Some of it may exist in footage shot by the British and other of our allies; some may even be available from former enemy sources. (See article, Don't Ignore It, Explore it, AIR-SEA RESCUE, March 1946.)

It is felt that a definite program should be set up and placed in operation at the earliest opportunity to provide for all PICAO members such vital information. The fastest, surest, most understandable method of assuring that standardized information is provided lies in the use of the motion-picture medium.

I. *History*

1. BETWEEN TWO WARS

DURING the war, the rapid organization c world network of airways by the Air Transp Commands of the Allied Nations focused attention the problems and great possibilities of civil air tr port. It became clear that rules for civil aviatio mutually workable among the nations of the worl must be evolved and enforced by common cens The alternatives—postwar disorder in the air and inherent seeds of international economic and polit strife—were foreseen.

Out of these hopes and fears grew the Internatic Civil Aviation Conference. The broad purpose the conference, which began at Chicago on Noven 1, 1944, was to consider the speedy establishment o international civil air service pattern, so that the be fits of the immensely expanded wartime air transp tation might be brought to all peoples.

Such an international concept was not with precedent. In 1919, the Paris Convention had est lished the International Commission for Air Navi tion, which set up standards on technical matters a provided for the connection and exchange of in mation among member states. Although 33 nati adhered to the Paris Convention, a number of sta including the United States, the U. S. S. R., Ch and Brazil, were not parties to it.

The Pan American Convention on Air Navigat drawn up at Havana in 1928 and ratified by United States and nine other American Repub pledged members to observe certain principles in t

s with one another. Among these principles ıcluded that of the freedom of air passage. the Paris Convention, however, no attempt was .t Havana to develop uniform technical stand- Neither was there any provision made for pe- discussion of common problems through the of a permanent organization.

E CHICAGO CONFERENCE

ɔugh the Paris and Havana Conventions had a useful purpose, they were no longer con- as adequate to meet the changed situation in , resulting from the immense development of uring the war. In the early months of 1944, ited States initiated a series of exploratory dis- s with other governments interested in the de- ent of international civil aviation. These dis- s revealed sufficient agreement among the prin- ir powers to justify the expectation that "final ions" could be reached at an international con- . Accordingly, the United States issued invita- 55 allied and neutral States to meet in Chicago ember 1, 1944.

deliberations of the delegates of the 52 nations nted at Chicago resulted in the adoption of a of resolutions and recommendations constitut- final act of the conference. The final act also ed the texts of the Convention on International viation, the International Air Services Transit Freedoms) Agreement, the International Air ort (Five Freedoms) Agreement, and the In- greement on International Civil Aviation.

E CONVENTION AND THE REEMENTS

Permanent Convention, which will come into ɔon ratification by 26 States, laid down, by mu- eement among the delegates of the participat- tions of the Chicago Conference, certain es and set up machinery "in order that inter- l civil aviation may be developed in a safe and manner and that international air transport may be established on the basis of equality of nity and operated soundly and economically." ve draft sets of regulations, dealing with tech- ɔjects, were adopted. They were incorporated o the final act. The technical annexes were he participating States for study and to serve ls for future international regulations. Meet- echnical subcommittees were to be set up, to the recommended practices for air navigation "as ones toward which the national practices of the several States should be directed as far and as rapidly as may prove practicable."

Both the International Air Services Transit Agreement and the International Air Transport Agreement are supplementary agreements.

The former grants to signatory States two reciprocal privileges:

(*a*) That of flying across the territory of a given State without land.

(*b*) That of landing for nontraffic purposes.

The Transport Agreement included the two privileges of the Transit Agreement, adding to them:

(*c*) The privilege of disembarking passengers and unloading mail and cargo taken on in the territory of the State whose nationality the aircraft possesses.

(*d*) The privilege of embarking passengers and loading mail and cargo destined for the territory of the State whose nationality the aircraft possesses.

(*e*) The privilege of embarking passengers and loading mail and cargo destined for the territory of any other contracting State and the privilege of disembarking passengers, mail and cargo coming from any such territory.

Recognizing the need for immediate action and the fact that a considerable time might elapse before the formalities of ratification of the convention were completed by the required number of States, the conference provided, through the Interim Agreement on International Civil Aviation, for the establishment of a provisional organization of a technical and advisory nature to function until the convention came into force.

II. *The Provisional International Civil Aviation Organization*

1. THE INTERIM AGREEMENT

The Interim Agreement provides that a provisional international organization, known as the Provisional International Civil Aviation Organization, be established. With headquarters in Canada, it will operate until a new permanent convention on international civil aviation comes into force or until other arrangements have been agreed upon at another conference on international civil aviation. In any event, the duration of PICAO is not to exceed 3 years from the coming

into force of the Interim Agreement. The governing bodies of the organization are the Interim Assembly and the Interim Council.

2. THE INTERIM ASSEMBLY

The assembly of PICAO is composed of delegates from member states, each state represented being entitled to one vote. Decisions are made, unless otherwise provided, by a simple majority of the member states present. The assembly is convened by the council and meets annually, through extraordinary meetings may be called at any time by the council or at the request of any 10 member states of the organization.

Member states as of April 1946 were:

Afghanistan.	Lebanon.
Australia.	Liberia.
Belgium.	Luxembourg.
Brazil.	Mexico.
Canada.	Netherlands.
Chile.	New Zealand.
China.	Nicaragua.
Colombia.	Norway.
Czechoslovakia.	Paraguay.
Denmark.	Peru.
Dominican Republic.	Philippines.
Egypt.	Poland.
El Salvador.	Portugal.
Ethiopia.	Spain.
France.	Sweden.
Greece.	Switzerland.
Haiti.	Syria.
Honduras.	Turkey.
Iceland.	Union of South Africa.
India.	United Kingdom.
Iraq.	United States.
Ireland.	

Among the powers and duties of the assembly are the election of its president and other officers, and the election of member states to be represented on the council. The assembly determines its own rules of procedure and is responsible for the financial arrangements of the organization, including the approval of an annual budget. It also examines and takes action in matters referred to it by the council and may, at its discretion, refer to the council specific matters for the consideration of the latter body. Finally, the assembly deals with such matters as come within the sphere of action of the organization but are specifically assigned to the council.

3. THE INTERIM COUNCIL

A. *Composition.*—The Interim Council is the executive instrument of the organization and derives its powers and authority from the Interim Assembly. constitutes, in fact, an international parliament civil aviation matters. It is composed of not m than 21 member states, elected by the assembly fc period of 2 years.

In electing members of the council, the assem must give adequate representation to:

(*a*) Those member states of major importance air transport;

(*b*) Those member states not otherwise inclu which make the largest contribution to the provis of facilities for international civil air navigati and

(*c*) Those member states not otherwise inclu whose election will ensure that geographical area the world are represented.

The following states are now represented on council:

Australia.	France.
Belgium.	India.
Brazil.	Iraq.
Canada.	Mexico.
Chile.	Netherlands.
China.	Norway.
Colombia.	Peru.
Czechoslovakia.	Turkey.
Egypt.	United Kingdom.
El Salvador.	United States.

Decisions taken by the council are valid only w approved by the majority of the council. Any m ber state not represented on the council may partici in the deliberations of the council, but without right to vote, if a decision is to be taken wl specifically concerns any such state. Similarly, vitations may be extended to nonmember states, re sentatives of public international organizations, pu or private bodies or authorities, to participate in cc cil meetings or to send observers. Such invitat do not, of course, carry the right to vote.

B. *Functions.*—The council has certain spe functions which are set out in the Interim Agreem

It must provide for the establishment of such sidiary working groups as may be considered desira among which there will be a Committee on Air Tr port, a Committee on Air Navigation, and a Com tee on International Convention for Civil Aviatio

The council supervises and coordinates the wor the three technical committees, receives and consi their reports, transmits to each member state t reports together with the findings of the council, makes recommendations, with respect to techı

;, to the member states of the assembly individ-
r collectively.

council has also to maintain liaison with the :r states of the organization. It must receive, ·, and hold open, for inspection by member all existing contracts and agreements relating to services landing rights, airport facilities, or nternational air matters to which any member r any airline of a member state, is a party. It s an annual report to the assembly and, when ;ly so required by all parties concerned, it may an arbitral body on any differences arising member states in regard to international civil n matters. The council, in such an event, may render an advisory report or make a decision all parties concerned must accept as final if ıve previously agreed to adopt this latter course. ›ng its administrative duties, it must determine :thod of appointment, salaries, and conditions ice of employees and serve as the final authority expenditures of the organization.

)fficers.—The Interim Council has elected a :nt, Dr. Edward Warner, and a secretary gen-)r. Albert Roper. The functions of the presi- : the council are to convene and preside at meet- the council and to act as the council's perma- epresentative. The council has also elected ımong its members three vice presidents, Dr. Copes van Hasselt (Netherlands), Col. C. Y. (China), and Dr. Guillermo E. Suarez nbia).

secretary general is the chief executive and strative officer of the organization. He is re- ›le to the council for carrying out duties assigned by that body. It is his responsibility to select ›point the staff of the secretariat, whose activi- supervises and directs.

'inances.—The expenses of the organization ·ne by the member states in proportions decided assembly. Each member state has been re- l to advance funds, in accordance with the scale :ed by the council, in order to cover the initial es of the organization.

. Adherence to the Interim Agreement

ıe conclusion of the Chicago Conference, on ber 7, 1944, prompt measures were taken to bring into being the Provisional International Civil Aviation Organization. By June 6, 1945, the required number of 26 nations had adhered to the Interim Agreement, and the way was clear for a committee of the Canadian Government to make arrangements for the first meeting of the Council of the Provisional International Civil Aviation Organization.

IV. The Canadian Preparatory Committee

A Canadian Preparatory Committee was formed in June 1945, with instructions to make all necessary arrangements for the first session of PICAO. Offices were established in Montreal and a staff was obtained on loan from various Canadian Government departments. The secretary general of ICAN was also invited to participate.

Due mainly to its accessibility by air transport, the city of Montreal was selected by the committee as the most suitable Canadian city for the site of PICAO. August 15, 1945, was selected as the date for the opening of the first session of the Interim Council. Arrangements were made for temporary housing of the secretariat in the Dominion Square Building, Montreal, and office equipment and furniture were supplied on loan by the Canadian Government. The council was able to hold its first session in a little over 2 months after the necessary signatures had been obtained to bring the Interim Agreement into effect.

V. Council Sessions

The Interim Council, which is deemed to be in continuous session, has been convened on four occasions.

The first session, which opened August 15, acting on recommendations made by the Canadian Preparatory Committee, continued the initial organization work and was mainly procedural in character. Dr. Edward Warner was elected president of the Interim Council, ceasing to represent his country, the United States, upon his election. Dr. Albert Roper, formerly secretary general of the International Commission for Air Navigation, was appointed Secretary General of the Organization.

By the second session of the council which opened October 15, the permanent Committees on Air Navi-

gation, Air Transport, Personnel, and Finance were functioning and reports were submitted for the approval of the council. To examine the specific problems of air navigation facilities and services, the session decided to convene a series of route service meetings throughout the world.

Among the important decisions made by the council at the third session beginning January 21, was the adoption of the texts of the Standards and Recommended Practices developed by the first group of technical divisions of the Air Navigation Committee.

The fourth session was convened on April 2.

VI. *Committees and Divisions*

Among the powers and duties assigned to the council by the Interim Agreement was the establishment of the Interim Committees on Air Transport, Air Navigation and International Convention on Civil Aviation.

Of these three permanent committees, the Committees on Air Navigation and Air Transport are well advanced with their programs. The Committee on International Convention on Civil Aviation is not as yet in operation. The Committee on Air Transport has the function of studying "any matters affecting the organization and operation of international air services." The Committee on Air Navigation "studies, interprets, and advises on standards and procedures with respect to communications systems and air navigation aids and recommends the adoption of minimum requirements and standards." These standards and recommended practices aim at achieving uniformity in international air operations.

Due to the amount of detailed work that is involved in the drafting of these standards and recommended practices, the Air Navigation and the Air Transport Committees have been so organized that the initial work of drafting is assigned to various divisions, including working groups on aerodomes, air routes and ground aids, rules of the air and air traffic control, meteorology, communications, search and rescue, maps and charts, personnel licensing, investigation of accidents, air line operating practices, and airworthiness.

Six of these technical groups—rules of the air and air traffic control communications, meteorology, search and rescue, maps and charts, and ground aids—have submitted their final reports to the committee. The reports set forth standards and rec mended practices, as well as 'recommendation measures which the groups feel would be benef in their respective fields.

The Air Transport Committee has, at present, division on facilitation of air transport. This div has prepared a report upon customs procedures manifests, public health regulations, travel docum facilities, and procedures for monetary exchange, other related matters, with a view to removing minimizing obstacles to air travel at internati borders. The report was sent to 42 member s for their consideration.

In addition to the Interim Committees and divisions, administrative committees to deal finance, personnel, publications, credentials, and lic information have been set up.

As indicated by its name, the Finance Comm prepares the budget of the organization and, amor other functions, it reports to the council on the a ment and collection of contributions of member st

The Personnel Committee advises on persc policies and makes recommendations to the secr general on appointments.

The Publications Committee advises on the pri of the organization's publications, notably the c of the organization, which is to appear monthly u the name of the Picao Journal and of which will be an English, French, and Spanish edition.

The Credentials Committee determines the ty information required in credentials presented by gates of states.

The Public Information Committee advises on licity matters and is responsible for the inform policy of the organization.

VII. *Languages ai Publications*

Work of the organization is conducted and its lications and documents are issued in the three of languages of PICAO: English, French, and Spa The organization has a publications and docur section which is responsible for all translations an publication of the Picao Journal, a monthly pul tion on the organization's activities.

The organization is also preparing a multilang aeronautical dictionary of standard definitions.

Publications issued to date are: Recommenda

ˌO for International Standards, Practices, and ıres on charts, communications, air traffic, mes and ground aids, meteorology, search and ccidents investigation, and personnel licensing. ˁ standards, which will cover airworthiness and operating practices, are in preparation. Spe- orts will be published on regional meetings as ›ther future activities.

VIII. *Regional Meetings*

the work of PICAO technical groups it is ɖ there will emerge standards that will make form flying procedures on international air ınd help in opening up the world to com- air traffic.

nplement these standards and recommended s as rapidly as possible, PICAO has launched ım of regional meetings. These meetings will · the standards and their application to the re- ·nts of particular regions. The meetings will ıother major task: to consider the value, for ·, of the facilities developed during the war by ːd Governments.

not generally realized how great was the ex- re of energy and money on the establishment intenance of facilities and services for military ːt routes. Many hundreds of airports were ˀeather observation stations and search and ːentres were established. Without these fa- ınd services, civil aviation would be seriously pped; yet the conditions of their operation evitable change, and require international ·ation.

ırst of the regional meetings, called by PICAO these problems on a regional basis, was held in on 4 March to consider the North Atlantic Thirteen nations took part: Belgium, Canada, k, France, Holland, Iceland, Ireland, Norway, l, Spain, Sweden, the United Kingdom, and ted States.

ˌecond meeting was held in Paris starting 23 consider the European-Mediterranean region. ·two nations took part.

ɖdle East region meeting is scheduled at Cairo summer, and other meetings for the South Caribbean, South Atlantic, South America, Indian Ocean, and North Pacific, will take ːer.

IX. *Liaison With Other International Organizations*

PICAO also maintains liaison with other international organizations such as: the International Commission for Air Navigation, the International Technical Committee of Experts in Air Law, the International Air Transport Association, the International Chamber of Commerce, the International Meteorological Organization, the International Telecommunications Union, the International Hydrographic Bureau, the Institute of Geography and History of the Pan American Union, the Federation Aeronautique Internationale, and the International Labour Office.

SAFETY AID FOR TRANSATLANTIC FLIGHTS INAUGURATED

In the interest of promoting maximum safety in transoceanic flight, a daily surface ships' position service has been inaugurated by Air Sea Rescue Headquarters, Eastern Sea Frontier.

Each day at 1200 EST (1700 GMT) this headquarters will furnish CAA communications (WSY) La Guardia Field, N. Y., with a list of estimated positions of ships known to be sailing to and from Europe and North America and being near to the overseas airline routes. This information will be retransmitted by CAA to the operation offices of overseas airlines in the form of a notice of airmen (NOTAM), for dissemination to the crews of their transatlantic flights.

The first column of this notice to airmen contains the international radio call. The second column contains the name of the vessel; the third, its destination. In the fourth column are indicated the hours of radio watch which the vessel stands; the figure 24 indicating continuous watch, 16 indicating a 16-hour daily watch, 8 indicating 8 hours of continuous watch, and X8 indicating that 8 hours of total watch are stood at various periods during each day.

The fifth column indicates the anticipated speed of the vessel in knots. The sixth and seventh columns indicate the estimated position of the vessel at 1700 GMT on the date of the report, latitude (north) first, longitude (west) second. The last column indicates the vessel's intended true course.

short shorts

Special Binoculars Used for Navy's Night Lookout Operations

Night-fighter pilots, ship lookouts, and submarine lookouts searching dark horizons in wartime operations used special binoculars developed at the instigation of the Navy's Bureau of Aeronautics.

Since ordinary search glasses are of little use at night because the fovea, the eyes' central focus point for day vision, becomes a blind spot, the Bureau's Instruments Branch had two manufacturers develop binoculars with an exceptionally wide field of vision.

After training in the proper use of the new binoculars, pilots found they could greatly extend their range of vision in locating and identifying objects at night. Finally, exposed surfaces of the glasses were given a nonreflecting coating in order to transmit the maximum amount of light.

Two types of wide-angle binoculars, one magnifying six times, the other seven, proved the most practical for maximum range at night without sacrificing a wide field of vision. These are being increasingly used by ship and aircraft personnel.

70 Weekly Transatlantic Trips

A forecast of 70 trans-Atlantic trips a week was given at a meeting of PICAO's North Atlantic Route Service conference. Frequencies expected to be in effect by the end of 1946 were: TWA 18, PAA 10, AOA 9, BOAC 14, TCA 7, SILA (Sweden) 3, DDL (Denmark) 3, DNL (Norway) 1, KLM (Netherlands) 2 or 3, Air France 2. *American Aviation.*

change of address

By the time you read this, the Air Sea Rescue Agency will have moved to its more centrally locate[illegible] Washington at 1300 E Street, [illegible]n-ber is EXecuti[illegible]- 5007-5011-5[illegible]

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AIR SEA RESCUE LIAISON OFFICERS

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Eastern Sea Frontier
90 Church St., New York 7, N. Y.

T. J. Harris, *Commander*, USCG
Western Sea Frontier
Federal Bldg., San Francisco, Calif.

Vacancy

Vacancy
ComAirPac, Coast Guard Box No. 1
Navy 48, San Francisco, Calif.

O. D. Weed, *Commander*, USCG
c/o Commander, 17 CGDistrict
Ketchikan, Alaska

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Land and Water
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LAND Landing Areas
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Alternate
WATER Landing Areas
Regular
Alternate
NORTH ATLANTIC REGION
PICAO
Air Sea Rescue Agency. May 1946
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CANADA
U. S.
AFRICA
BW-1
Keflavik
Reykjavik
Goose
Botwood
Gander
Stephenville
St. Johns
Montreal
Presque Isle
Montcon
Shediac
Boucherville
Sydney
Bangor
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